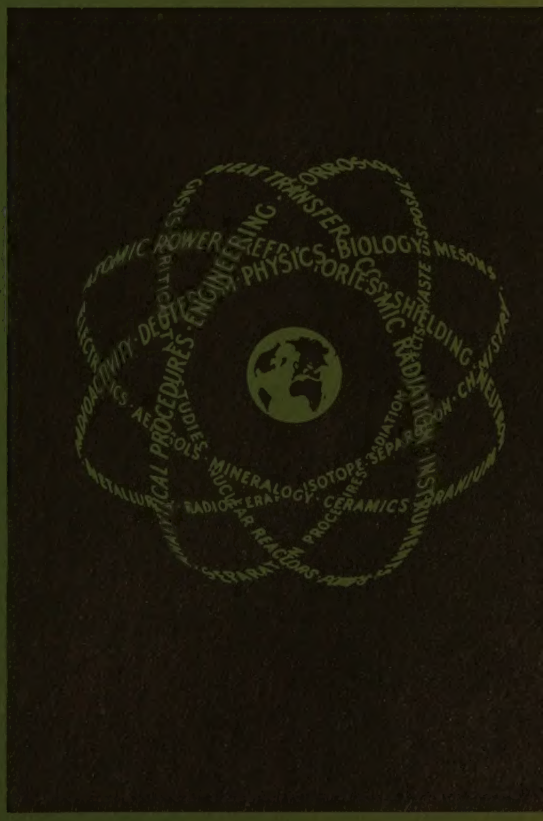
NUCLEAR SCIENCE ABSTRACTS



January 31, 1959

Volume 13 Number 2
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NUCLEAR SCIENCE ABSTRACTS

A Publication of the United States Atomic Energy Commission Technical Information Service

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The printing of this publication has been approved by the Director of the Bureau of the Budget, July 30, 1957.

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NUCLEAR SCIENCE ABSTRACTS

Volume 13 Number 2 January 31, 1959

GENERAL

500 EES-010327

Naval Engineering Experiment Station, Annapolis.
LINDE MOLECULAR SIEVES AS DYNAMIC DEHUMIDIFICATION DESICCANTS. Progress Report. John W. Cadorette and D. M. Zall. Apr. 12, 1957. 19p.

Four samples each of three types of Linde Molecular Sieves were evaluated as dynamic desiccants. The molecular sieves had high water vapor adsorption capacities at low relative humidities. This suggests their possible use in drying compressed gases, such as aviators' breathing oxygen. The high capacity at low and midrange humidities and their rapid absorption rates make them ideally suited for use in dynamic humidifiers. However, they cannot be used in dehumidification machines designed for use with Grades H and L desiccant unless the machines are modified to provide higher reactivation temperatures. The high reactivation temperature indicates ability to adsorb moisture at very high temperatures. This suggests possible use as desiccants for high-temperature air streams, such as between stages of multiple-stage compressors. (C.H.)

501 NP-6993

Organization for European Economic Co-operation, Paris.
FIRST REPORT ON THE ACTIVITIES OF THE AGENCY PRESENTED TO THE CONSULTATIVE ASSEMBLY OF THE COUNCIL OF EUROPE. Sept. 1958. 81p.

The general organization and initial activities of the European Nuclear Energy Agency are reviewed for the six months' period starting with the official creation of the Agency. Activities include a survey of methods for European cooperation in the field of experimental and prototype reactors, the organization of the Eurochemic Company for the chemical processing of irradiated fuels, enactment of an agreement for the joint operation of the Norwegian boiling water reactor, a survey of the possibilities of producing heavy water in Iceland, proposals for liberalizing international trade in nuclear materials, a survey of existing training facilities in Europe, the drafting of basic health standards for all European countries, drafting an agreement on the liabilities of operators of nuclear plants, the formation of estimates of the production and requirements of Europe in energy during the next few years, and arranging a European conference for the Spring of 1959 to discuss industrial prospects in the field of nuclear energy. (C.H.)

502 AEC-tr-3334

BUILDINGS OF CERN IN GENEVA. (Die Bauten des CERN in Genf). Thomas Jaeger. Translated for Oak Ridge National Lab. from Bauingenieur 32, 262-75 (1957). 41p.

The complex problems, the structural design of the installations, and the specialties of actual construction of the CERN buildings and machines are discussed. (W.D.M.)

503

ATOMIC ENERGY: GENERAL DESCRIPTION. J. R. Brunner. Zurich, Verlag Leemann, 1957. 83p. (In German)

A general survey is given of the historical development of knowledge on atomic energy. The topics discussed include atomic theory, radiation, atomic fission and its explosive effects, peaceful uses of atomic energy, instruments for producing elementary particles, and the atom in the universe. (J.S.R.)

504

COURSE OF ATOMIC ENGINEERING. VOLUME I, II, III, IV-A, IV-B, V-A, V-B, VI, VII-A, VII-B, and VIII. Gif-Sur-Yvette (S. & O.), France, Centre D'Études Nucléaires de Saclay, 1957. 2745p. (In French)

The textbooks used at the Centre d'Études Nucléaires at Saclay for the course in atomic engineering are presented. The subjects covered are "Fundamentals in Nuclear Physics," "Electronics and Control of Reactors," "Neutron Theory," "Fundamentals of Reactors," "Description and Future Prospects of Reactors," "Physical Chemistry," "Metallurgy and Chemistry," and "Radiation Protection." (J.S.R.)

BIOLOGY AND MEDICINE

505 AECU-3841

Oklahoma. Agricultural Experiment Station, Stillwater.
BIOCHEMICAL MECHANISM OF NITRATE REDUCTION IN BACTERIA. Final Report [for Period] July 1, 1951-June 30, 1958. 29p. Contract AT(11-1)-71, Project No. 4. $4.80(ph OTS); $2.70(mf OTS).

Includes Progress Report No. 5 for Period February 1, 1956-June 30, 1958. Sept. 1, 1958.

The pathways of nitrate reduction in bacteria were investigated. The schemes support the theory that the pathway of nitrate reduction proceeds via nitrite, hydroxylamine, and in some organisms ammonia may serve as an intermediate. Organisms capable of utilizing pyruvic oxime as a carbon and nitrogen source were isolated and identified as belonging to the genus Alcaligenes. Pseudomonas fluorescens was shown to be capable of growing on p-nitrobenzoic acid as a sole source of organic carbon and nitrogen, and a Flavobacterium utilized o-nitrobenzoic acid as a source of

organic carbon and nitrogen. Results indicate that both of these compounds are metabolized via adaptive enzymes. A scheme for nitrate reduction is presented. (C.H.)

506 AECU-3842

Montefiore Hospital, New York.

THE DEVELOPMENT OF CHELATING AGENTS FOR ENHANCING THE URINARY EXCRETION OF STRONTIUM. Period Covered: Dec. 1, 1957 to Sept. 1, 1958. Harry Kroll. Sept. 2, 1958. 27p. Contract AT(30-1)-2094. $4.80(ph OTS); $2.70(mf OTS).

A group of chelating agents was prepared and screened for their effectiveness in enhancing the urinary excretion of strontium-85 in laboratory animals. Data are tabulated. (C.H.)

507 AECU-3847

Michigan State Univ., East Lansing.

ABSORPTION OF RADIONUCLIDES THROUGH THE ABOVE-GROUND PARTS OF PLANTS, WITH SPECIAL REFERENCE TO PRODUCTS OF NUCLEAR FISSION. H. B. Tukey, S. H. Wittwer, W. G. Long, and F. G. Teubner. [July 1955]. 19p. Contract [AT(11-1)-159]. (M-5667). $3.30(ph OTS); $2.40(mf OTS).

The above ground, or aerial, parts of plants were found to absorb radionuclides readily from external spray applications. Entry through leaves, stems, fruit, and bark were demonstrated. The rate of absorption, extent of subsequent transport, and pattern of distribution within the plant was found to be dependent upon the nature of the radionuclide and many internal and external factors. These factors are discussed. It is concluded that the above ground parts of plants can absorb radionuclides which occur as fission products in an atomic fall-out, and that the hazard exists that these substances may be incorporated into plant tissues. (C.H.)

508 AECU-3851

[Long Island Biological Assn.]. Biological Lab., Cold Spring Harbor, N. Y.

THE ROLE OF HETEROZYGOSITY IN DROSOPHILA POPULATIONS. Bruce Wallace. [1958]. 18p. Contract AT(30-1)-557. $3.30(ph OTS); $2.40(mf OTS).

An analysis was made of the viability effects of radiation-induced mutations in heterozygous condition in populations of Drosophila. The results of seven large experiments involving the examination of more than 9000 cultures and the counting of more than three and a quarter million flies are summarized in tabular form. Limitations of the experimental procedures and results of the experiments are discussed. (C.H.)

509 AECU-3852

[Long Island Biological Assn.]. Biological Lab., Cold Spring Harbor, N. Y.

STUDIES OF THE RELATIVE FITNESSES OF EXPERIMENTAL POPULATIONS OF DROSOPHILA MELANOGASTER. Bruce Wallace. [1958]. 40p. Contract AT(30-1)-557. $6.30(ph OTS); $2.40(mf OTS).

An attempt was made to estimate the relative fitnesses of several experimental populations of D. melanogaster. The measure of fitness used was the number of offspring produced by single pairs of individuals. Fifty males and virgin females from each of two competing populations were mated as single pairs. Records were made on sterile matings and offspring produced after 14 days. The experiments were continued for 10 generations. All possible pairs of eight populations were studied. Estimates of fitness varied between different samples of flies taken from the same population, between different generations of the same sample, between fertility and number of offspring produced, and in different generations during the course of the experiments. It was concluded that the fitness of a population is not a constant which can be measured, recorded, and then referred to when occasion demands. 20 references. (C.H.)

510 AECU-3856

Rochester, N. Y. Univ. School of Medicine and Dentistry.

ISOTOPE DILUTION AS A MEASURE OF BODY COMPOSITION IN MAN. Gilbert B. Forbes. [Aug. 1957]. 23p. Contract [AT(30-1)-1827]. (M-6271). $4.80(ph OTS); $2.70(mf OTS).

Comparisons of estimation of total body H_2O, Na, K, and Cl in man by isotopic dilution and carcass analysis are presented. Comparable values are achieved in the case of all four tracers in the newborn infant, but only for water in the adult. It would seem proper to continue to refer to results for Na, K, and Cl isotopic analyses in the adult as representing total exchangeable content rather than total body content. (auth)

511 AMRL-368

Army Medical Research Lab., Fort Knox, Ky.

INFLUENCE OF CYSTEINE ON THE INTESTINAL EPITHELIUM OF X-IRRADIATED RATS. R. P. Beliles, J. G. Kereiakes, and A. T. Krebs. Aug. 20, 1958. 22p. Project No. 6-59-08-014.

Cysteine affords protection against x-ray induced mitotic inhibition of the epithelium cells of the small intestine in rats given 100 r and 300 r whole-body irradiation. For the 300 r dose level, the rate of recovery of the mitotic activity was about the same for both non-treated and cysteine-pretreated groups. The time of depression of mitotic activity varied with radiation dose. A disappearance of crypt structure in the higher dose range, 1000 r and 3000 r, was noted. The protective effect of cysteine on crypt structure was reflected by increased survival at 1000 r and increased survival time at 3000 r. (auth)

512 AMRL-369

Army Medical Research Lab., Fort Knox, Ky.

EFFECTS OF X-RAYS ON PREFORMED ANTIBODIES. A. J. Luzzio and V. Evangelinos. Oct. 28, 1958. 10p. Project No. 6-59-08-014.

Exposure of bacterial agglutinins, in immune sera, to various doses of x rays resulted in the inactivation of specific immunologic combining sites. Other sites in the same sera remained relatively stable at the same dose levels. The results reported indicate antibodies possess specific radiosensitivities and may be removed selectively from a polyvalent serum. The evidence presented suggests that denaturation of antibody protein by ionizing radiation proceeds in an orderly sequence. (auth)

513 BNL-3801

Brookhaven National Lab., Upton, N. Y.

INFORMATION THEORY OF RADIATION MORTALITY. Henry Quastler. [1958]. 11p. $3.30(ph OTS); $2.40 (ph OTS).

In information theory, one makes use of a relation between probability of malfunction of a system and its internal stability, expressed in informational terms. Many forms of radiation damage are the result of numerous independent perturbations with individually small and supplementary effects. In these cases, it may be appropriate to measure the amount of radiation damage in terms of the total amount of disorder produced. This can be expressed as amount of reduction of information content. Manifest radiation damage may be

associated with reduction of information content below a certain critical level. Derivations are presented which bring out the generality of the concepts involved in radiation injuries. Derivation from a multi-target model and from a general model are presented and an application to radiation mortality is presented. (C.H.)

514 HW-56636

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

TRANSLOCATION AND EXCRETION OF PULMONARY DEPOSITED PLUTONIUM OXIDE. W. J. Bair. Aug. 1, 1958. 13p. Contract W-31-109-Eng-52. $0.50(OTS).

The excretion of plutonium in urine and feces during the period two to 46 days after intratracheal administration of plutonium oxide in dogs is described by power functions. Of the small per cent of administered plutonium appearing after ten days in tissues other than the lung, the pulmonary lymph nodes, ovaries, and bones showed relatively high concentrations. No relationship between the estimated lung burden and the blood and urine content could be derived. The excretion data were used successfully to test a published equation for estimating the plutonium content of the lung ten days after exposure to plutonium oxide. (auth)

515 MLM-67

[Mound Lab., Miamisburg, Ohio.]

ACUTE EXPOSURE TO POLONIUM. (MEDICAL STUDY OF THREE HUMAN CASES.) David H. Naimark. Mar. 4, 1948. Decl. June 23, 1958. 25p. Contract AT-33-1-GEN-53. $4.80(ph OTS); $2.70(mf OTS).

Three individuals were inadvertently exposed to polonium. Activity determinations on the routine weekly urine samples submitted by the individuals revealed counts of 174, 734, and 2190 c/min/50 ml respectively. An investigation was immediately launched to determine the source of the exposure, since there was no report of a spill or accident involving active material. By the process of elimination, the time of exposure was narrowed down to a time when two of the individuals were engaged in the denitration of a polonium solution in a small kettle inside a hood when a leak developed in the kettle. The active solution was transferred from the kettle to a carboy. All three individuals were present during the transfer period. Two wore respirators, rubber gloves, and smocks over their coveralls while the third stood well behind and watched the procedure. However, it was concluded that an inhalation exposure resulted. A medical study of each case was instituted and data are summarized. No immediate toxic effects were observed. (C.H.)

516 UCLA-398

California. Univ., Los Angeles. Atomic Energy Project.

EFFECTS OF BICARBONATE AND OTHER ANIONS ON THE UPTAKE OF P32, Ca45, Fe59, Rb86, Sr90, Ru106, Cs137, AND Ce144 BY BEAN AND BARLEY PLANTS. J. A. Goss and E. M. Romney. June 28, 1957. 23p. Contract AT-04-1-GEN-12. $4.80(ph OTS); $2.70(mf OTS).

Solution culture experiments were conducted with bean and barley plants to study the uptake of P32, Ca45, Fe59, Rb86, Sr90, Ru106, Cs137, or Ce144 under treatments which included a control and 10 me of NaCl, $NaNO_3$, Na_2SO_4, or $NaHCO_3$ per liter of solution. After an 8-hour period of uptake, the plants were harvested and radioassayed. Except for Cs137, the uptake of each isotope was significantly decreased by the $NaHCO_3$ treatment. This decrease was not caused solely by the pH, Na ion concentration, or osmotic pressure of the nutrient solution, but was associated with the presence of the bicarbonate anion. It was concluded that the inhibited uptake was caused by plant-bicarbonate interactions. (auth)

517 UCLA-408

California. Univ., Los Angeles. Atomic Energy Project.

THE DEVELOPMENT OF LEUKEMIA AND OTHER NEOPLASMS IN MICE RECEIVING CELL-FREE EXTRACTS FROM A HIGH LEUKEMIA (AKR) STRAIN. Esther Fincher Hays and William S. Beck. Oct. 8, 1957. 19p. Contract AT-04-1-GEN-12. $3.30(ph OTS); $2.40 (mf OTS).

An increased incidence of leukemia in hybrid mice was demonstrated by inoculating newborn animals with cell-free extracts of leukemic tissues of an inbred strain with a high incidence of spontaneous leukemia. Parotid and mammary carcinomas and subcutaneous fibrosarcomas have been shown to develop in hybrid mice receiving leukemic extracts from mice of a different strain in the newborn period. (auth)

518 UCRL-8189

California. Univ., Berkeley. Radiation Lab.

THE METABOLISM AND TOXICITY OF RADIUM-223 IN RATS. Patricia W. Durbin, C. Willet Asling, Nylan Jeung, Marilyn H. Williams, James Post, Muriel E. Johnston, and Joseph G. Hamilton. Feb. 21, 1958. 76p. Contract W-7405-eng-48. $2.00(OTS).

A study was made of the excretion and retention of tracer and toxic doses of the 11.2-day radium-223 isotope in rats. Data are presented on acute toxicity as demonstrated by changes in organ weight, gross and microscopic pathology, and iron-59 utilization by bone marrow, and long-term histopathological changes and alterations in the hemogram. A procedure for calculation of radiation dose to the skeleton and bone marrow is appended. 41 references. (C.H.)

519 UCRL-8203

California. Univ., Berkeley. Radiation Lab.

THE HEMOGLOBIN CONTENT OF SINGLE ERYTHROCYTES IN CELL AGING AND HEMOPOIETIC DISTURBANCE (thesis). Charles Anderson Sondhaus. Mar. 11, 1958. 80p. Contract W-7405-eng-48. $2.25 (OTS).

The method of microspectrophotography, which can measure the amount of light-absorbing substance in a single cell, was used to determine the hemoglobin concentration per unit area, the total dry mass of hemoglobin (Hb), and the cell diameter of single erythrocytes in dry smear preparations. Limitations in the technique are discussed from the point of view of the accuracy and applicability of the results obtained under the given conditions. Applications of the technique in health and disease are reported. (C.H.)

520 UCRL-8278

California. Univ., Berkeley. Radiation Lab.

PHOTOSYNTHESIS. Melvin Calvin. June 1958. 31p. Contract W-7405-eng-48. $6.30(ph OTS); $3.00(mf OTS).

The use of tracer carbon, as carbon-14, has made possible considerable progress in the mapping of the routes taken by the carbon atom from CO_2 into plant substances. The techniques of separation and identification that have made the progress possible lie largely in the region of chromatography and radioautography involving fractional-gamma amounts of material. Most of the earlier steps of carbon incorporation are now known. In addition, a number of the later steps on the routes to

amino acids and proteins and other plant substances are now under investigation. As a result of the recognition of the earlier stages of carbon incorporation, a number of proposals have been made about the photochemical act itself. These proposals have led to the development of direct physical tests of their validity, and some results of these will be described. The remaining principal area of investigation involving the route of oxygen atoms from water to molecular oxygen is largely unexplored, but the use of new methods of analyzing for the heavy isotopes of oxygen may make possible more progress in this area. 44 references. (auth)

521 USNRDL-TR-254

Naval Radiological Defense Lab., San Francisco.
ANTIGENIC STIMULI FOR TRANSPLANTATION IMMUNITY TO RAT BONE MARROW HETEROGRAFTS IN LETHALLY X-IRRADIATED MICE. C. W. Santos, L. J. Cole, and R. M. Garver. July 7, 1958. 28p.

In connection with studies on heterologous bone marrow transplantation in x-irradiated mice, the question arose as to whether the antigenic stimulus for rejection of such marrow heterografts was solely confined to nuclear fractions as has been reported for skin homografts. Accordingly, LAF_1 mice were divided into groups of 10 to 15, and injected intraperitoneally 7 to 10 days prior to an LD_{100} dose of x radiation (870 r) and injection with rat bone marrow, with one of the following suspensions or solutions: rat bone marrow, rat liver, rat red blood cells, non-nuclear lyophilized fraction of rat bone marrow, rat serum, and Tyrode's solution. Blood smears were made on all surviving animals at 7, 14, and 30 days post-irradiation and treated by the alkaline phosphatase technique. All animals injected with Tyrode's solution before irradiation and rat marrow treatment showed rat granulocytes (alkaline phosphatase positive) in the peripheral blood at 7, 14, and 30 days. Animals that had been given rat serum prior to irradiation showed no rat cells in the peripheral blood at 7 and 14 days. However, 3 surviving mice at 30 days did show rat granulocytes in their blood. No rat granulocytes were found at one week in the blood of mice which has received the other treatments. All of these latter mice died before the 14 day. Ten autopsies were performed on mice from these groups between 8 to 10 days post-irradiation. No rat granulocytes were found in the spleen, liver, lungs or bone marrow of these mice. The data suggest that non-nuclear material may act as one of the direct or indirect stimuli for rejection of a "non-solid" heterograft, in this instance bone marrow cells. (auth)

522 AEC-tr-3402

A COMPARISON OF THE EFFECT OF X-RAYS AND FAST ELECTRONS FROM A 6 MEV BETATRON ON GROWTH AND CELL DIVISION IN VICIA FABA EQUINA. H. J. Schmermund and H. L. Heinrich. Translated for Los Alamos Scientific Lab. from Strahlentherapie 86, 227-40(1952). 10p.

A comparison was carried out between the biological effect of various doses of x rays from a 180 kv generator and of electrons from a 4 Mev batatron on mitosis of root tip cells of Vicia faba. The following served as criteria of radiation damage: increase in weight of irradiated soaked bean seedlings; the frequency of chromosomal fragmentations and bridge formations in cells in anaphase and telophase; shortening of M- and m-chromosomes in cells in metaphase; and changes in the frequency of cell division. It was shown that electron bombardment is less effective than x rays with respect to all of the criteria examined. This constitutes additional support for the idea that differences in effectiveness of the two types of radiation in multiple hit events are determined by differences in ionization and in the size of groups of ion pairs formed. (auth)

523 AERE-Lib/Trans-801

ACTION OF IONIZING RADIATIONS ON THE GROWTH AND DEVELOPMENT OF CERTAIN AGRICULTURAL PLANTS. L. P. Breslavets, N. M. Berezina, G. I. Shchibrya, and M. L. Romanchikova. Translated by R. C. Murray (U.K.A.E.A., Atomic Energy Research Establishment) from Biofizika 1, 628-32(1956). 7p.

The beneficial action of pre-sowing irradiation of the seeds of certain plants can be taken as quite established both by our experiments, and those of others. We correlate the stimulating action of x rays with an increase in the number of cell divisions. But this is undoubtedly a secondary effect of radiation. The primary effect must be sought in a physico-chemical change in the cells. Our results confirm those of many authors concerning the differing sensitivities of different plant species to radiations. For carrots the stimulating dose is 2000 to 4000 r, whereas for radishes it lies between 500 and 1000 r. It has been found that it is wrong to limit observations to the first stage in development, since in many cases doses stimulating the onset of growth may have no effect at later stages of development. (auth)

524 NP-tr-187

THE VALUE OF CERTAIN METHODIC CONDITIONS IN TISSUE REACTIONS ON THE LOCAL EFFECT OF CENTIMETER WAVES. K. F. Grishina. Translated for Lincoln Lab., MIT from Biofizika 3, 358-63(1958). 11p.

The character of the heating of skin and the vascular reactions of a human under the local effect of emissions from a therapeutic centimeter wavelength generator were investigated. Data are tabulated. (C.H.)

525 UCRL-Trans-366

A STUDY OF PHOTOOXIDATION SENSITIZED BY CHLOROPHYLL AND PHEOPHYTIN. G. P. Brin and A. A. Krasnovskii. Translated by G. A. Somorjai (Univ. of Calif. Radiation Lab., Berkeley) from Biokhimiya 22, 776-88(1957). 15p.

The conditions of oxidation of ascorbic acid sensitized by chlorophyll and pheophytin were followed up. It was shown that, besides ascorbic acid, chlorophyll and pheophytin sensitize oxidation of cysteine, polyphenols, cytochrome c and other compounds. The chlorophyll and pheophytin sensitized oxidation occurs with those hydrogen donors which have the capacity to photoreduce these pigments. This, along with other studies in this laboratory, substantiates the mechanism of the reaction which consists of a light stage of photoreduction of the pigment and a dark stage of oxygen interaction with the photoreduced form of the pigment. Along with chlorophyll solutions, great activity is exhibited by colloid solutions obtained by means of detergents among which the most active proved emulphor, the condensation product of oleilic alcohol with ethylene oxide. (auth)

526

VARIATION IN THE PICTURE OF THE PERIPHERAL BLOOD IN MICE SUBJECTED TO TOTAL IRRADIATION UNDER SPLEEN SCREENING AND UNDER ITS LOCAL IRRADIATION. Z. N. Faleeva (Severtsov Inst. of Animal Morphology, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R. 122, 65-8(1958) Sept. 1. (In Russian)

A relatively long period of leukopenia followed by restoration to normal was observed in cases of animals

exposed to total irradiation with screened spleen, while a very brief period of leukopenia followed by a chronic leucocytosis was observed in the cases of local spleen irradiation. Spleen screening does not prevent the development of blood reaction to general irradiation, however, in cases of spleen screened exposure, the restoration processes begin sooner and are more energetic than in the instances of total exposure without spleen protection. (R.V.J.)

527
MONITORING SCATTERED RADIATION AROUND DIAGNOSTIC X-RAY APPARATUS. F. Minarik, K. Durcek, and A. Minarik. Pracovni lekarstvi, Praha 10, 141-4(1958). (In Czech.)

Radiation intensities are plotted at various points of the diagnostic apparatus and the intensity doses determined. (R.V.J.)

528
SAFETY MEASURES IN HANDLING RADIOISOTOPES. V. Slouka (Purkyne Military Medical Academy, Hradec Kralove). Pracovni lekarstvi, Praha 10, 176-8(1958). (In Czech.)

Experience acquired in the Purkyne Military Medical Academy in Hradec Kralove City and in English isotope laboratories is described. Personal hygiene and protection of personnel, safety techniques, decontamination, and waste disposal are discussed. Suggestions are made for improvements in working conditions and techniques. (tr-auth)

529
MANOMETRIC X RADIATION ACTINOMETER AND THE EFFECT OF X RADIATION ON THE FERMENTATION OF CANCER CELLS. Otto Warburg, Walter Schröder, H. S. Gewitz, and Wolfgang Völker (Max-Planck Inst., Berlin-Dahlem). Z. Naturforsch. 13b, 591-6(1958) Sept. (In German)

The anaerobic fermentation of ascites cancer cells, suspended in Ringer's solution at low cell densities, was inhibited by x-radiation doses of 1000 r at 50%. With the help of these "fermentation tests" it was found that the radiation effect can be reduced by the hydrogen peroxide which the radiation produces in the cell suspension. A manometric x-radiation actinometer was developed for these investigations. (tr-auth)

530
RADIOACTIVE ISOTOPES IN CLINICAL PRACTICE. Edith H. Quimby, Sergei Feitelberg, and Solomon Silver. Philadelphia, Lea & Febiger, 1958. 451p.

A textbook is presented which is divided into three parts: basic physics, instrumentation and laboratory methods, and clinical applications. (T.R.H.)

CHEMISTRY

General

Refer also to abstracts 985, 988, 1012, 1014, 1016, 1017, and 1027.

531 AERE-Inf/Bib-115
United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.
THE PREPARATION AND PROPERTIES OF THE CARBIDES OF SCANDIUM, YTTRIUM, THE ACTINIDES AND THE LANTHANIDES. A BIBLIOGRAPHY. R. G. P. Towndrow, comp. July 1958. 17p. $0.45 (BiS).

One hundred and three references to American and British reports and the published literature are given. (T.R.H.)

532 CF-54-5-91
Oak Ridge National Lab., Tenn.
FREE ENERGIES OF FORMATION OF OXIDES AND FLUORIDES. J. M. Cisar. May 5, 1954. Changed from OFFICIAL USE ONLY Sept. 26, 1958. 16p. $3.30(ph OTS); $2.40(mf OTS).

A compilation of data from the open literature for the free energies of formation of several simple fluorides and oxides was made. In addition, the free energies of oxide to fluoride reactions were computed. The values are tabulated and presented in graphs constructed as straight lines except in a few cases in which the deviations from linearity were large. The error which may arise from use of straight lines is recognized. (J.R.D.)

533 CF-54-8-64
Oak Ridge National Lab., Tenn.
MEASUREMENTS OF THE ELECTRICAL CONDUCTIVITY OF MOLTEN FLUORIDES. N. D. Greene. Aug. 16, 1954. Decl. Sept. 26, 1958. 22p. Contract [W-7405-eng-26]. $4.80(ph OTS); $2.70(mf OTS).

Measurements of the electric conductivity of molten fluorides from 1000 to 1700°F, together with a brief description of the measuring apparatus, are given. Redeterminations of the electrical conductivity of KNO_3, NaOH, and $LiNO_3$ melts were found to be within ±10% of values reported. (J.E.D.)

534 CF-56-1-49
Oak Ridge National Lab., Tenn.
DETERMINATION OF SMALL AMOUNTS OF TANTALUM IN NaF–LiF–KF AND IN NaF–LiF–KF–UF_4. J. C. White. Jan. 10, 1956. Decl. Sept. 26, 1958. 10p. Contract [W-7405-eng-26]. $1.80(ph OTS); $1.80(mf OTS).

The pyrogallol method was modified for the determination of small amounts of tantalum in NaF–LiF–KF and NaF–LiF–KF–UF_4. In order to prevent the loss of tantalum during dissolution of the samples as the volatile fluoride, tantalum fluoride was hydrolyzed with dilute sulfuric acid prior to the complete removal of fluoride ions, which interfere with this method, by heating in concentrated sulfuric acid. Since uranium also interferes with the pyrogallol method, tetravalent uranium was oxidized to uranyl, and tantalum was separated from the oxidized uranium by precipitation with cupferron in a strong sulfuric acid solution. The coefficient of variation for the determination of tantalum in both types of samples was 2 per cent. (auth)

535 HW-56875
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
INTERIM REPORT ON THE LABORATORY INVESTIGATION OF CARBON STEEL DECONTAMINATION. J. E. Mendel. July 22, 1958. 14p. Contract [W-31-109-Eng-52]. $3.30(ph OTS); $2.40(mf OTS).

Indications are that carbon steel can be adequately decontaminated from activated corrosion products. Decontamination factors of 10 to 20 and corrosion rates of less than 0.02 mils/hr were obtained with several formulations. Decontamination of stainless steel in the presence of carbon steel is more difficult. Oxalic acid and modifications of the Turco 4501 process appear promising. Dissolution of UO_2 in several noncorrosive alkaline media has been demonstrated. H_2O_2-carbonate appears most applicable for loop decontamination. Fission product behavior has not yet been investigated. (auth)

536 IDO-14441

Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.

THE EFFECT OF SILICON IN THE REPROCESSING OF A URANIUM ALUMINUM ALLOY. O. W. Parrett and K. L. Rohde. May 10, 1958. 24p. Contract AT(10-1)-205. $0.75(OTS).

The insoluble residues produced during the reprocessing of certain nuclear fuel elements containing aluminum, silicon, and uranium were investigated with respect to particle size, shape and distribution, composition, and surface-active tendencies. The fuel material samples studied contained from 0.4 to 7.0% silicon by weight (the high analysis represents a cast base AlSi alloy). The fuel materials were dissolved in mercury-catalyzed nitric acid. Two types of solid residue were produced by actual fuel dissolution. One was a finely divided material, brown in color and the other was black, crystalline material relatively large in size. Only the black crystalline material was obtained when cast AlSi was dissolved in nitric acid. Spectrographic analysis of the residues showed that silicon and aluminum were the major constituents. X-ray diffraction analysis of each type indicated the presence of elemental silicon only. The x-ray pattern obtained with the brown material showed lower intensities indicating the presence of amorphous material. Under a magnification of 970 diameters, the crystals observed appeared to be non-uniform, shallow platelets of irregular shape. The bulk of the residue is removed by a 10-micron filter; however, the resulting filtration rates are very low, (2.0 gallons per hour per square foot). Sedimentation data of typical dissolver solution showed that about 20% of the silicon particles have equivalent diameters of 20 μ or greater, that 25% have equivalent diameters between 10 and 20 μ and the remaining have equivalent diameters of less than 10 μ. Dispersion-coalescence data disclosed minor surface active tendencies which appear to be insufficient to cause unusual extraction column operation. The particle size, distribution, and surface-active tendencies were not affected by aging. (auth)

537 IDO-14448

Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.

RUTHENIUM BEHAVIOR IN A NITRIC ACID SCRUBBER. C. E. May, B. J. Newby, K. L. Rohde, and B. D. Withers. Sept. 29, 1958. 45p. Contract AT(10-1)-205. $1.25(OTS).

When nitrate-containing fission product wastes are treated by high temperature processes the ruthenium may be volatile. If a device such as an air-fluidized bed calciner is used, an off-gas stream of air, oxides of nitrogen, and water is produced which may contain volatile ruthenium as the tetroxide. The chemical aspects of the scrubbing of ruthenium from such a gas stream have been studied using both a bench scale scrubber and an equilibrium still to define the pertinent vapor-liquid equilibria. The effects of ruthenium species, ruthenium and nitric acid concentration, temperature, and air flow on the equilibria have been defined. The operation of the bench scale scrubber is described as well as the relationship between the scrubber operating parameters, the vapor-liquid equilibrium values, and the maximum decontamination factor obtainable. In agreement with related ruthenium volatility data in boiling nitric acid solutions, the scrubber vapor-liquid equilibria show a sharp break in ruthenium volatility at a liquid phase concentration of 10M nitric acid. At lower acid concentration fairly effective ruthenium removal may be predicted. By assuming ideal solutions the portion of the liquid phase ruthenium present as the tetroxide may be calculated. This value appears to be about 1 percent at 80°C in less than 10M nitric acid but rises to essentially 100 percent in 12M acid. (auth)

538 ISC-857

Ames Lab., Ames, Iowa.

BASIC PRINCIPLES INVOLVED IN THE MACRO-SEPARATION OF ADJACENT RARE EARTHS FROM EACH OTHER BY MEANS OF ION EXCHANGE. J. E. Powell and F. H. Spedding. [1956]. 47p. Contract [W-7405-eng-82]. $7.80(ph OTS); $3.30(mf OTS).

The separation of rare earth mixtures by ion exchange using ammonium ethylenediaminetetraacetate and ammonium N-hydroxyethylethylenediaminetriacetate as eluting agents is discussed in detail. Simple countercurrent separation theory is used to predict the minimum number of displacements of an adsorbed band that are necessary in order to separate the components of binary mixtures. It is shown how the theory can be applied to even more complex systems, and experimental data are presented for some of the more difficultly separable groups of rare-earth species. Experimental results agree very well with the theoretical predictions. (auth)

539 ISC-944

Ames Lab., Ames, Iowa.

TRANSPORT NUMBERS AND ION MOBILITIES IN THE FUSED SALT KCl–$PbCl_2$. Richard A. Fleming and F. R. Duke. Dec. 1957. 82p. Contract W-7405-eng-82. $2.25(OTS).

Values of ionic transport numbers and ionic mobilities were determined for the fused system KCl–$PbCl_2$. Cation transport numbers of 0.24 (525°C) and 0.78 (850°C) were found for $PbCl_2$ and KCl, respectively. In each mixture studied t_- deviated positively and both t_+ and t_{++} deviated negatively from linearity when plotted against equivalent fraction. The initial very rapid depression of total equivalent conductance from that of pure KCl, caused by addition of small amounts of $PbCl_2$, was found to be due to the depression of the ionic conductance of K^+ rather than complexing between Pb^{++} and Cl^- as had been previously supposed. Values of ϕ were compared with those in the system LiCl–$PbCl_2$, calculated from available literature data. (auth)

540 ISC-946

Ames Lab., Ames, Iowa.

SUBSTITUENT EFFECTS OF THE STABILITY OF METAL CHELATES. Wilfred G. Borduin and G. S. Hammond. Dec. 1957. 28p. Contract W-7405-eng-82. $1.00(OTS).

The stability constants of the chelate compounds of a series of substituted diaroylmethanes with several divalent metals in 75 per cent by volume dioxan-water were measured. The data were treated with the Hammett relationship, $\log k/k_0 = \rho\sigma$. The expected correlation of rho values with metal-chelate bond type was not observed. This lack of correlation is attributed to the free energy of solution of the metal chelate. If the measured rho values are to reflect the ionic-covalent character of the metal-chelate bond, it must be assumed that the free energy of solution of the metal chelates is independent of the metal. In general, this assumption is not valid. In this case it appears that this free energy term completely swamps out effects relating to the bond type. (auth)

541 ISC-947

Ames Lab., Ames, Iowa.

PROCESSING OF MONAZITE SANDS. John J. Braghusen and M. Smutz. Dec. 1957. 110p. Contract W-7405-eng-82. $2.50(OTS).

A detailed description is presented of a process developed by Ames Laboratory for the separation of thorium, rare earths, and uranium from monazite sands. Oxalic acid is used to precipitate rare earths and thorium from a sulfate and phosphate solution of these elements. The possibility of recovering uranium from the oxalate filtrate by anion exchange was investigated. (W.L.H.)

542 ISC-1045
Ames Lab., Ames, Iowa.
FURTHER RELATIONSHIPS IN THE GRUNWALD TREATMENT OF ACID-BASE EQUILIBRIA IN HYDROXYLIC SOLVENTS. Wilfred G. Borduin and G. S. Hammond. Dec. 1957. 53p. Contract W-7405-eng-82. $1.50.

It was observed by Grunwald that acid-base equilibria in several pure and mixed hydroxylic solvents could be treated by the relation log $f_A/f_{AH} - m_A Y$ wherein f_A and f_{AH} are degenerate activity coefficients of a base and its conjugate acid, respectively, m_A is a parameter depending only upon the base, and Y is a parameter depending only on the solvent and charge type of the base. It is shown in this work that the proton donating ability of a solvent can be related to a suitable function of appropriate m_A values. Utilizing Grunwald's data for mixtures of water and ethanol, values of m_A are derived for the solvent components. In addition, a relationship is derived between the proton donating ability of a solvent and the Hammett acidity function. This relationship is shown to correlate data already available in the literature on the Hammett acidity function in water-ethanol mixtures. (auth)

543 KAPL-1662
Knolls Atomic Power Lab., Schenectady, N. Y.
REACTOR FUELS SUSPENDED IN LIQUID METALS. [PART] I. LABORATORY STUDY OF VOLUMINOUS URANIUM DIOXIDE. S. C. Furman. Feb. 8, 1957. Decl. Oct. 7, 1958. 14p. Contract W-31-109-eng-52. $3.30(ph OTS); $2.40(mf OTS).

A voluminous form of uranium dioxide has been prepared by the decomposition of both ammonium diuranate and uranium(VI) peroxide precipitated on cellulose filter aid. The material has a bulk density of approximately 0.1 gm/cc. The particle size is 5 to 6μ with crystallite sizes as low as 0.06μ. The UO_2 is wet by sodium or NaK. Growth of UO_2 particles in suspensions of UO_2 and NaK appears to be hindered by the addition of oxygen getters. (auth)

544 KAPL-M-ABR-5
Knolls Atomic Power Lab., Schenectady, N. Y.
CREVICE CORROSION OF ZIRCALOY. Alan B. Riedinger. Aug. 12, 1958. 25p. Contract W-31-109-Eng-52. $4.80(ph OTS); $2.70(mf OTS).

Zircaloy-3 crevice specimens with varying amounts of retained nitric and hydrofluoric acids have been corrosion-tested in 750°F steam for 28 days, 680°F water for 112 days, and 550°F water for 168 days. These tests show that after an initial period of abnormally rapid corrosion, the corrosion rate becomes normal. The 550°F water test is continuing for a total of 364 days to obtain further confirmatory results. (auth)

545 KAPL-M-ELS-9
Knolls Atomic Power Lab., Schenectady, N. Y.
THE DETERMINATION OF RESIDUAL CHLORIDE ON A PIPE SURFACE AFTER VAPOR PHASE DEGREASING. E. L. Shirley. Sept. 12, 1958. 6p. Contract W-31-109-Eng-52. $1.80(ph OTS); $1.80(mf OTS).

The advisability of vapor-phase degreasing with chlorinated hydrocarbons has been questioned. Tests on steel pipe sections after degreasing with both trichloroethylene and perchloroethylene show that a water-soluble chloride residue does remain. This residual water-soluble chloride is appreciably reduced by either 70°F distilled water rinsing or a standard acid pickling. (auth)

546 KAPL-M-JTP-3
Knolls Atomic Power Lab., Schenectady, N. Y.
THE POLAROGRAPHIC DETERMINATION OF URANIUM IN URANIUM–ZIRCONIUM ALLOYS AND IN URANIUM OXIDE–ALUMINA CERAMICS. J. T. Porter, II. Aug. 5, 1958. 17p. Contract W-31-109-Eng-52. $3.30(ph OTS); $2.40(mf OTS).

The application of the polarographic method to the determination of uranium in uranium–zirconium alloys and in urania–alumina ceramics was investigated. The precision of such an analysis is approximately 0.6% relative. The procedure is simple, involves no separations, and is free from interference of tungsten, copper and iron in amounts normally present in fuel alloys and ceramic materials. (auth)

547 KAPL-M-RFD-1
Knolls Atomic Power Lab., Schenectady, N. Y.
CHEMICAL ANALYSIS OF IRON, NICKEL, ALUMINUM, SILICON, AND CALCIUM IN DYSPROSIUM METAL. R. F. Dufour. Aug. 1, 1958. 9p. Contract W-31-109-Eng-52. $1.80(ph OTS); $1.80(mf OTS).

The analyses of iron, nickel, aluminum, silicon, and calcium impurities in dysprosium metal were performed routinely and without deviation from standard procedures. Colorimetric methods were used in determining iron, nickel, aluminum, and silicon, while calcium was determined flame photometrically. The standard addition technique was used for all analyses and where possible, separations were made in order to check effects of dysprosium. (auth)

548 KAPL-M-RFD-2
Knolls Atomic Power Lab., Schenectady, N. Y.
TUNGSTEN INTERFERENCE IN VOLUMETRIC ANALYSIS OF URANIUM. R. F. Dufour and O. Articolo. Aug. 4, 1958. 9p. Contract W-31-109-Eng-52. $1.80 (ph OTS); $1.80(mf OTS).

Tungsten was found to have a negligible effect on the determination of uranium in uranium–zirconium alloys by the Jones reductor–dichromate method used at KAPL. The tungstate ion interferred seriously and gave high results. However, the soluble tungsten was precipitated by intensive fuming with sulfuric acid and rendered ineffective in the subsequent oxidation-reduction reactions of the uranium. (auth)

549 KAPL-M-VFC-4
Knolls Atomic Power Lab., Schenectady, N. Y.
DETERMINATION OF BORON IN URANIUM–ZIRCONIUM FUEL. V. F. Consalvo. Sept. 2, 1958. 8p. Contract W-31-109-Eng-52. $1.80(ph OTS); $1.80(mf OTS).

A combination of the sulfuric acid dissolution procedure and the carminic acid method has been applied with some modifications to the determination of boron in uranium-zirconium fuel clad with Zircaloy-II. The procedure was developed on "as received" fuel in preparation for the determination of residual boron in irradiated samples. (auth)

550 KAPL-M-VFC-5
Knolls Atomic Power Lab., Schenectady, N. Y.
THE DETERMINATION OF BORON IN BORON CARBIDE–ZIRCONIUM CLAD WITH ZIRCALOY. Vivian F. Consalvo. Oct. 2, 1958. 8p. Contract W-31-109-Eng-52. $1.80(ph OTS); $1.80(mf OTS).

A method is described for the determination of >10 milligrams of boron in boron carbide–zirconium material clad with Zircaloy. The sample is refluxed in quartzware with concentrated hydrochloric acid plus 1:20 hydrofluoric acid. The acid insoluble residue is filtered, ashed, and fused with sodium carbonate. The melt is dissolved in hydrochloric acid, and adjusted with sodium hydroxide to precipitate any hydrolyzable elements which may interfere with the final boron titration. The boron in the HCl-HF soluble filtrate is separated from the bulk of the zirconium with a barium carbonate precipitation. The acid insoluble and acid soluble boron are then determined individually by a potentiometric mannitol titration. (auth)

551 LAMS-1674
Los Alamos Scientific Lab., N. Mex.
SEPARATION OF SMALL AMOUNTS OF SCANDIUM FROM URANIUM. Karl S. Bergstresser. May 1954. Decl. Oct. 1, 1958. 15p. Contract W-7405-eng-36. $3.30(ph OTS); $2.40(mf OTS).

A method for separating small amounts of scandium (1 to 10 mg) from a gram of uranium depends upon formation of insoluble uranium peroxide while the scandium in solution is complexed with ethylenediaminetetraacetic acid. The precipitated peroxide carries down less than 30 ppm of scandium. Uranium left in solution, less than one milligram in amount, does not interfere when the scandium is precipitated as ammonium scandium tartrate and determined gravimetrically by ignition of the tartrate to the oxide. (auth)

552 NBS-5892
National Bureau of Standards, Washington, D. C.
A REVIEW OF THE PROPERTIES OF DEUTERIUM AND TRITIUM COMPOUNDS. Annual Bibliography—1956. Virginia R. Johnson and Irwin Oppenheim. May 31, 1958. 81p. NBS Project No. 0302-11-2641. $12.30(ph OTS); $4.50(mf OTS).

The references in the bibliography are arranged alphabetically according to the last name of the leading author. Each reference is numbered by a letter-number symbol corresponding, respectively, to the last letter of the leading author's last name and numerical listing under that letter. The names of co-authors are listed alphabetically and cross-indexed. Compound and subject indexes are included. The arrangement and methods of coding and indexing follow those of the Bibliography of Research on Heavy Hydrogen Compounds by A. H. Kimball, and edited by H. C. Urey and I. Kirshenbaum. This bibliography contains 434 references to published research on deuterium and tritium compounds and was compiled entirely from volume 50 (1956) of Chemical Abstracts. (auth)

553 NEPA-545
Fairchild Engine and Airplane Corp. NEPA Div., Oak Ridge, Tenn.
SUMMARY OF THE PROPERTIES OF THE MORE FAMILIAR LITHIUM COMPOUNDS. Mary Anne Hyla. Revised by Dorothy H. Fisher. May 21, 1948. 40p. Contract [W-33-08-sc-14801(16250)].

A summary of the physical properties of the more familiar lithium compounds is presented. The information is tabulated alphabetically by compound name, and a bibliography (25 references) is included. (J.R.D.)

554 NYO-7947
Pennsylvania State Univ., University Park. Coll. of Mineral Industries.
ON THE CHEMICAL CONSTITUTION OF A LIGNITIC RESIN (thesis). James Joseph Tietjen. July 18, 1958. 61p. Contract AT(30-1)-2000. $1.75(OTS).

A sink-float procedure, employing a mixture of n-heptane and CCl_4 as the separation medium, is a satisfactory means of separating the resins from the coal in a pure form. These resins are primarily resin acids and esters. The resin acids are composed of two major fractions, amber and a form of oxidized abietic acid. The oxidized abietic acid component has undergone self-condensation to form an ester. The condensation probably results in a lower concentration of chromophoric groups. The observations indicate that the resins have undergone only a moderate degree of alteration during the coalification process. (auth)

555 ORNL-2491
Oak Ridge National Lab., Tenn.
DEVELOPMENT OF A CONTINUOUS ION EXCHANGE PROCESS FOR THE REMOVAL AND RECOVERY OF HIGH-PURITY CESIUM FROM ALKALINE WASTE. I. R. Higgins and A. F. Messing. Nov. 6, 1958. 32p. Contract W-7405-eng-26. $1.00(OTS).

A process was developed for the removal and recovery of high-purity cesium from alkaline waste solutions using the Higgins continuous countercurrent ion exchange contactor. Cesium is selectively sorbed on the phenolic methylene sulfonic resin Duolite C-3, along with strontium, the rare earths, and other cationic fission products. At feed rates up to 2000 gal/ft^2 hr, tracer activities in a synthetic alkaline waste solution were reduced to background levels of 0–50 c/ml min, corresponding to decontamination factors of $>10^4$ for cesium and $>10^3$ for strontium and the rare earths. Cesium was removed from the contactor by selective elution with hydrochloric acid to produce a product containing about 1% sodium along with tracer quantities of strontium and the rare earths. A cost estimate was prepared which showed that Cs^{137} would cost 6 cents per curie from a plant designed to produce 22,000 curies/day. (auth)

556 ORNL-2570
Nuclear Development Corp. of America, White Plains, N. Y.
DETERMINATION OF OXYGEN IN LITHIUM METAL. H. I. Sax and H. Steinmetz. Oct. 31, 1958. 9p. For Oak Ridge National Lab. Contract W-7405-eng-26, Subcontract No. 981. $0.50(OTS).

A method for the determination of the oxide content of lithium has been developed. This method is specific for oxygen and is of sufficient sensitivity to perform analysis in the range of 10 to 100 ppm of oxide. (auth)

557 WAPD-CTA(GLA)-156(Rev. 1)
Westinghouse Electric Corp. Bettis Plant, Pittsburgh.
THE DETERMINATION OF SILICON AS AN IMPURITY IN ZIRCONIUM AND ZIRCALOY. G. W. Goward, B. B. Wilson, and S. Kallman. Apr. 29, 1957. 5p. $1.80 (ph OTS); $1.80(mf OTS).

Hydrofluoric acid is used both to dissolve the sample and convert the silicon to a reactive form. The silicon is reacted with molybdic acid to form molybdisilicic acid, which is then reduced to a heteropoly blue complex. Photometric measurement is made at 815 mu. The method covers the determination of silicon as an impurity in zirconium and Zircaloy in the range of 10 to 200 ppm on a one gram sample basis. (auth)

558 WAPD-CEA(GLA)-157(Rev.1)
Westinghouse Electric Corp. Bettis Plant, Pittsburgh.
THE DETERMINATION OF TITANIUM AS AN IMPURITY IN ZIRCONIUM AND ZIRCALOY. R. O. Backer and G. W. Goward. Apr. 18, 1957. 6p. $1.80(ph OTS); $1.80(mf OTS).

Titanium forms a yellow complex with hydrogen peroxide in a 1.5 to 3.5 N sulfuric acid solution. The color

development is instantaneous and is stable for at least 24 hr. The maximum absorbance of the complex is at 410 mu. The method covers the determination of titanium as an impurity in zirconium and Zircaloy. The range of the method is from 10 to 100 ppm on a one gram sample basis. The principle interferences are vanadium and molybdenum. They must either be removed or a correction made for them. The interference of colored ions such as iron, nickel and chromium (III) is compensated for by the use of a portion of the sample solution, not treated with peroxide, in the reference cell. (auth)

559 WAPD-CTA(GLA)-180(Rev. 1)
Westinghouse Electric Corp. Bettis Plant, Pittsburgh.
THE DETERMINATION OF TUNGSTEN AS AN IMPURITY IN ZIRCONIUM AND ZIRCALOY. K. L. Cheng, G. W. Goward, and B. B. Wilson. Apr. 19, 1957. 5p. $1.80(ph OTS); $1.80(mf OTS).

The addition of stannous chloride and potassium thiocyanate to an acid tungstate solution results in a colored tungsten thiocyanate complex which exhibits a maximum absorbance at 400 mu. The method covers the determination of tungsten in the range from 25 to 400 ppm on a half-gram sample basis. The effects of impurities and alloying additives in zirconium and Zircaloy are compensated by the use of a blank consisting of a sample in which the thiocyanate color is not developed. Without a blank of this type chromium and nickel interfere to the extent that they are colored in solution. More than 0.10 mg of copper present in the sample taken for analysis results in a precipitate of cuprous thiocyanate. Filtration prior to color measurement eliminates this interference. (auth)

560 WAPD-CTA(GLA)-192(Rev. 1)
Westinghouse Electric Corp. Bettis Plant, Pittsburgh.
THE DETERMINATION OF MOLYBDENUM AS AN IMPURITY IN ZIRCONIUM AND ZIRCALOY. G. W. Goward and R. M. Burd. Mar. 17, 1957. 4p. $1.80 (ph OTS); $1.80(mf OTS).

Molybdenum(V) reacts with thiocyanate in acid solution to form a stable complex which is extracted with butyl acetate. The butyl acetate solution of the complex exhibits an absorbance maximum at 472 mμ. The method covers the determination of impurity molybdenum in zirconium and Zircaloy over the range of 5 to 50 ppm on a one gram sample basis. Tungsten interferes to the extent that 500 μg is equivalent to 0.9 μg of molybdenum. (auth)

561 WAPD-CTA-(GLA)-323
Westinghouse Electric Corp. Bettis Plant, Pittsburgh.
TENTATIVE METHOD FOR THE DETERMINATION OF BORON AS AN IMPURITY IN ZIRCONIUM AND ZIRCALOY. G. W. Goward, H. R. Wilson, and M. A. McCracken. Jan. 25, 1957. 7p. $1.80(ph OTS); $1.80 (mf OTS).

Zirconium or Zircaloy is dissolved in sulfuric acid. Boron is separated from the sample by distillation as methyl borate into a sodium hydroxide–methanol mixture. Methanol is removed by evaporation and boron is determined spectrophotometrically as the curcumin complex in a methanol–oxalic acid solution. The method covers the determination of boron in zirconium and Zircaloy in the range 0.1 to 0.7 ppm on a one gram sample basis. (auth)

562 Y-1233
Union Carbide Nuclear Co. Y-12 Plant, Oak Ridge, Tenn.
DEVELOPMENT OF A CONTINUOUS COUNTER-CURRENT HIGH EFFICIENCY GAS-SOLIDS CONTACTOR. R. P. Levey, Jr., A. de la Garza, S. C. Jacobs, H. M. Heidt, and P. E. Trent. Sept. 3, 1958. 80p. Contract W-7405-eng-26. $2.25(OTS).

Experimental conversions of UO_3 to UO_2 and UO_2 to UF_4 in a batch fluidized bed pilot-scale contactor have demonstrated that conversion rates approaching those predicted from basic kinetic data are attainable. Further studies with fluidized beds in columns incorporating a very slight taper show that solids mixing with attendant product contamination is reduced by a factor of ten as a direct result of the taper. Experiments with tapered fluidized beds made the design of continuous (as opposed to the step enrichment of a multistage contactor) countercurrent contactors practical. Design procedures, in generalized form, are presented. The procedures take into consideration heat transfer, mixing losses, reaction kinetics, and chemical equilibria. (auth)

563 AEC-tr-3305
ON A COLLOIDAL INTERPRETATION OF THE PHENOMENA OF CORROSION AND INHIBITION. (Sur une interprétation colloidale des phénomènes de corrosion et d'inhibition. Jean Frasch. Translated by the Oak Ridge National Lab. Library Staff from Corrosion et anti-corrosion 6, 9-14(1958). 13p.

Certain theories are presented which are based on experiments carried out on the colloidal nature of a majority of corrosion products. Attempts are made to introduce them into electro-chemical theory of corrosion and inhibition. (auth)

564 AEC-tr-3391
INVESTIGATION OF THE BaF_2–BeF_2 SYSTEM. D. F. Kirkina, A. V. Novoselova, and Yu (Iu.) P. Simanov. Translated by Alfred Monks from Zhur. Neorg. Khim. 1, 125-32(1956). 15p.

The BaF_2–BeF_2 system and $BaBeF_4$ were studied by x-ray and thermal methods. Preparation of the alloys is described, and results are tabulated, including the rhombic lattice crystal constants of $BaBeF_4$. It was concluded that BaF_2 in the presence of BeF_2 crystallizes in an unknown structure. (J.R.D.)

565
DETERMINATION OF URANIUM IN URANIUM HEXAFLUORIDE MATERIAL. C. A. Kienberger (Union Carbide Nuclear Co., Oak Ridge, Tenn.). Anal. Chim. Acta 19, 338-41(1958) Oct.

A rapid and precise method was developed for the determination of uranium in uranium hexafluoride material that contains essentially no non-volatile impurities. Approximately 7 g of uranium hexafluoride is transferred into a tared fluorothene tube, weighed, frozen, and hydrolyzed in 150 ml of ice-cold water in a platinum dish. The solution is evaporated to dryness, and the residue is ignited to urano-uranic oxide and weighed. The precision of a single analysis at the 95% confidence interval is ±0.06% of the value, with no significant bias. (auth)

566
DETERMINATION OF URANIUM, ZIRCONIUM, MAGNESIUM AND IRON IN BISMUTH ALLOYS. K. W. Kirby and R. H. A. Crawley (British Thomson-Houston Co., Ltd., Rugby, Eng.). Anal. Chim. Acta 19, 363-8 (1958) Oct.

Uranium in bismuth alloys is determined by a procedure where E.D.T.A. is added to complex bismuth and other metals and uranium oxinate is extracted by chloroform and determined spectrophotometrically. Zirconium is determined spectrophotometrically using alizarin S as reagent under carefully controlled conditions of acidity and time of color formation. Magnesium is determined indirectly by measuring the

absorption of oxine spectrophotometrically after precipitating the magnesium oxinate complex and redissolving. Bismuth is first separated by extraction of its iodide complex with methyl isobutyl ketone, and other interfering metals by extraction of their oxinate complexes at pH 6.5. Iron is determined as its thiocyanate complex after extraction with methyl isobutyl ketone, bismuth thiocyanate remaining in the aqueous phase. (auth)

567

THE EFFECT OF PRESSURE ON THE SOLUBILITY OF MOLECULAR HYDROGEN IN NIOBIUM AND TANTALUM. P. S. Perminov. Doklady Akad. Nauk S.S.S.R. 121, 1041-2(1958) Aug. 21. (In Russian)

The effects of pressure on the solubility of molecular hydrogen were studied at 620 to 680°C, at which the equilibrium saturation values are quickly stabilized and the hysteresis loop is always absent during increased or decreased pressure measurements. The data show that with pressure above atmospheric, a very sharp increase in solubility takes place, possibly related to the formation of hydrogen-rich phases. This is followed by a slowed logarithmically regular increase. For Nb–H the logarithmic relation was observed in the lattice-filled region from 0.53 to 0.73 g/g Nb. In Ta–H the logarithm law covers a wider range from 0.2 to 0.72 g/g Ta. It is assumed that further saturation of the Nb and Ta lattice would also proceed logarithmically. (R.V.J.)

568

PHENOLCARBOXYLIC ACIDS OF THE TRIPHENYLMETHANE SERIES APPLIED FOR ANALYSIS. THE DETERMINATION OF BERYLLIUM IN ROCKS, MINERALS, AND ALLOYS. I. S. Mustafin and L. O. Matveev. Zavodskaya Lab. 24, 259-62(1958). (In Russian)

A method is given for the colorimetric determination of beryllium using dichlorsulfodimethyloxyfuksondicarboxylic acid. The reagent is sensitive to 0.025 μ/ml of Be^{2+}. The measurements are made at $\lambda = 570$ mμ and pH 4.4 to 4.6. Trilon B is used to eliminate the interference of other ions. (J.S.R.)

569

THE DETERMINATION OF COBALT AND CADMIUM IN NICKEL OF HIGH PURITY. S. Ye. Kreymer, N. V. Tuzhilina, V. A. Golovina, and R. A. Tyabina. Zavodskaya Lab. 24, 262-4(1958). (In Russian)

Methods are described for the gravimetric determination of cobalt and cadmium in high-purity nickel. Diantipyryl methane is used as the precipitating reagent. (J.S.R.)

570

A COLORIMETRIC METHOD OF DETERMINING COPPER IN NICKEL ELECTROLYTES. A. I. Busev, M. I. Ivanyutin, and E. M. Feygina. Zavodskaya Lab. 24, 265-6(1958). (In Russian)

A method for the rapid colorimetric determination of copper, based on the reaction of the Cu^{2+} ion in a weakly acid medium with nickel diethyldithiophosphate, is reported. The deep yellow-orange copper diethyldithiophosphate is produced and extracted with carbon tetrachloride. It is insoluble in water, but soluble in organic solvents. (J.S.R.)

571

THE TRILONOMETRIC DETERMINATION OF NICKEL IN ALLOYED COPPER WITHOUT SEPARATION. I. L. Kalinichenko. Zavodskaya Lab. 24, 266-7(1958) (In Russian)

A method for the colorimetric determination of Ni in Cu alloys is reported. The Cu^{2+} is reduced to Cu^{+} with sodium thiosulfate, and the solution is then titrated through the color transition from yellow to red-violet with Trilon B at pH 8.5 to 9.5. The results are in good agreement with those obtained with other methods. (J.S.R.)

Radiation and Radiochemistry

572 APEX-411

General Electric Corp. Aircraft Nuclear Propulsion Dept., Cincinnati.

IRRADIATION TESTING OF ORGANIC LIQUIDS. G. W. Pomeroy and V. P. Calkins. Aug. 1955. 38p. Contracts AF33(038)-21102 and AT(11-1)-171. $1.25(OTS).

Summary of the results of irradiation tests of organic materials conducted in the HB-2 facility of the LITR and in the electron beam of the GE-ANPD-2-Mev Van de Graaff accelerator is reported. Several organic liquids capable of withstanding temperatures up to 650°F have been tested, and descriptions of the tests and typical data are presented. (auth)

573 CRDC-720

Atomic Energy of Canada Ltd. Chalk River Project, Chalk River, Ont.

DETERMINATION OF THE DIFFUSION CONSTANT OF FISSION XENON IN UO_2 CRYSTALS AND SINTERED COMPACTS. A. H. Booth and G. T. Rymer. Aug. 1958. 30p. (AECL-692). $0.50(AECL).

The diffusion of fission product xenon from UO_2 crystals and from compacted and sintered UO_2 pellets has been measured under a variety of conditions using Xe-133 as a tracer isotopes. The UO_2 specimens, containing Xe-133 formed as a fission product, were heated at constant temperature in a furnace. The diffusion constant was calculated from the fraction of the total xenon that diffused out in a definite time interval. With fused UO_2, i.e., well-crystallized UO_2 obtained by cooling a melt, the fraction evolved at any temperature was directly proportional to the square root of the time of heating and to the reciprocal of the radius of the crystals. This behavior is that anticipated from the simplest diffusion model. In contrast, with specimens consisting of fragments of pellets of sintered UO_2, the fraction evolved was independent of the dimensions of the fragments. Apparently, evolution of the xenon from the ceramic material is a two-stage process. The rate controlling step is an activated diffusion out of the oxide lattice to an interior surface in the porous material. The second step is a rapid permeation through the pore structure to the outside. The diffusion constant was found to vary greatly among pellets prepared by different techniques. A standard laboratory test is proposed to characterize the gas release property of a given batch. The method consists of representing the pellet as an aggregation of uniform spherical particles, and evaluating a parameter, D', equal to D/a^2, where D is the diffusion constant in the oxide lattice and "a" is the radius of the sphere. The value so obtained can be used to calculate the fraction of xenon fission gas evolved from a fuel element in an operating reactor over a given time interval. (auth)

574 KAPL-M-DGM-1

Knolls Atomic Power Lab., Schenectady, N. Y.

RADIOCHEMICAL INSTRUMENTATION ON THE POST IRRADIATION CORROSION LOOP. D. G. Miller and W. C. Judd. July 1, 1958. 14p. Contract W-31-109-Eng-52. $3.30(ph OTS); $2.40(mf OTS).

A brief summary is presented of the information gained through the radiochemical instrumental techniques employed during the first run of the post-irradiation corrosion loop. (W.L.H.)

575 AEC-tr-3408
OXIDIZING PROCESSES IN ORGANIC SYSTEMS UNDER THE INFLUENCE OF IONIZING RADIATION. N. A. Bakh and V. V. Saraeva. Translated by Oak Ridge National Lab. Library Staff from Zhur. Fiz. Khim. 32, 209-18(1958). 16p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 12, as abstract No. 10459.

576 AEC-tr-3416
SPECTROSCOPIC STUDY OF RADIOLYSIS OF HYDROCARBONS. L. S. Polak, A. V. Topchiev, N. Ya. (Ia.) Cherniak and I. Ya. (Ia.) Kachkurova. Translated for Atomics International from Doklady Akad. Nauk S.S.S.R. 119, 118-20(1958). 6p.

The radiolysis of alkanes using Co^{60} as a gamma source of 1400 to 20,000 curies was studied. The samples were irradiated in sealed glass ampoules, and upon opening the gaseous and liquid portions were studied separately. The greater part of the study concerned heptane; however, other alkanes, e.g., octane, isooctane, cyclohexane, n-hexane, n-dodecane, and n-cetane, are included. (J.R.D.)

577 AEC-tr-3417
RADIOLYSIS OF HEPTANE AND OF SOME OTHER ALKANES. L. S. Polak, A. V. Topchiev, and N. Ya. (Ia.) Cherniak. Translated for Atomics International from Doklady Akad. Nauk S.S.S.R. 119, 308-9(1958). 7p.

The basic laws and mechanisms of radiolysis in gamma irradiation of paraffinic hydrocarbons including n-heptane, n-hexane, isooctane, n-octane, n-dodecane, n-cetane, and cyclohexane were investigated, using a Co^{60} source of 1400 to 20,000 curies. The samples were sealed in ampoules of molybdenum glass. The results of analysis of the irradiated gases are included, and a discussion of free radical formation is presented. (J.R.D.)

578
INVESTIGATIONS ON THE ADSORPTION OF THE RADIOELEMENTS IN SOLUTION. I. ADSORPTION OF Pu^{4+} IN SULFURIC MEDIA. M. Haissinsky and Y. Laflamme. J. chim. phys. 55, 510-12(1958) July-Aug.

The adsorption of tetravalent Pu in sulfuric solutions on glass and platinum was studied in a Pu concentration range of 10^{-5} M. The adsorption is reversible, diminishing with an increase of the acidity. In all the cases examined it was extremely weak (lower than 0.01%). The adsorption on glass follows the Freundlich isotherm, and on platinum it follows the Langmuir isotherm. (tr-auth)

579
EFFECT OF IONIZING RADIATION ON AQUEOUS SOLUTIONS OF PERMANGANATE. Gabriel Simonoff (Inst. de Physique nucléaire, Orsay, France). J. chim. phys. 55, 547-58(1958) July-Aug.

The reduction of permanganate is explained by introducing the idea of average valence from which is found the reduction products after irradiation. It is shown that the permanganate is not completely reduced to Mn^{2+}, for sulfuric acid concentrations between 0.01 and 8N. This system is different from other reducible systems studied because of the fact that the OH radical does not reoxidize Mn^{2+} because of the reaction $2\ MnO_4^- + 3\ Mn^{2+} + 4\ OH^- \rightarrow 5\ MnO_2 + 2\ H_2[O]$. In the conditions where the yield is a maximum a value of 14 equivalents was found for 100 ev. This is explained if the hypothesis is made that each OH radical reduces 3 equivalents. An attempt was made to verify this hypothesis by collecting the OH radicals by the addition of benzene. (tr-auth)

Separation Processes for Pu and U

Refer also to abstracts 978, 981, 989, 1009, 1010, 1013, 1015, 1025, and 1026.

580 CF-54-6-244
Oak Ridge National Lab., Tenn.
THE EFFECTS OF CAUSTIC DISSOLUTION ON THE 25 EXTRACTION PROCESS. J. R. Flanary. June 29, 1954. Decl. Sept. 26, 1958. 11p. $3.30(ph OTS); $2.40(mf OTS).

The dissolution of U-Al slugs in caustic is examined in relation to the 25 Process. Various first-cycle flowsheets are discussed and compared to the current 25 process flowsheet in which nitric acid is used. The flowsheets have not been evaluated. (J.R.D.)

581 CF-54-7-203
Oak Ridge National Lab., Tenn.
THE EFFECT OF SOLVENT TRIBUTYL PHOSPHATE CONCENTRATION ON THE DECONTAMINATION OF URANIUM EXTRACTED FROM ALUMINUM NITRATE SOLUTIONS. G. I. Cathers. July 26, 1954. Decl. Sept. 26, 1958. 21p. Contract [W-7405-eng-26]. $4.80 (ph OTS); $2.70(mf OTS).

The results are reported of a study made to determine the effect of solvent TBP concentration on fission product decontamination of U extracted from $Al(NO_3)_3$ solutions. (auth)

582 CF-55-12-88
Oak Ridge National Lab., Tenn.
INVESTIGATION OF COUNTERCURRENT ION EXCHANGE FOR ISOLATION OF URANIUM-233. R. E. Leuze and V. C. A. Vaughen. Dec. 15, 1955. Decl. Sept. 26, 1958. 17p. Contract [W-7405-eng-26]. $3.30(ph OTS); $2.40(mf OTS).

A simplified procedure of operating the ion exchange columns for isolation of uranium-233 in the Thorex Pilot Plant was developed and tested on a laboratory scale. This procedure is based upon volume measurement instead of flowing stream analyses during elution. The essential features are upflow sorption and downflow elution at 70°C with a calculated volume of elutriant containing 3.0 M $NH_4C_2H_3O_2$, 1.5 M $HC_2H_3O_2$, and 0.75 M $(NH_4)_2HC_6H_5O_7$ followed by 5 column volumes of demineralized water. Countercurrent flow makes it possible to essentially eliminate acetate recycle through solvent extraction by leaving a small uranium heel on the resin instead of complete elution with large volumes of acetate tailings containing small amounts of uranium. The countercurrent operation also simplifies the procedure since the displacement volume is essentially constant for resin loadings for 25 to 80% of the theoretical capacity. The volume of produce can be calculated by dividing the grams of uranium loaded on the resin by the desired product concentration, for concentrations up to 200 g U/l. The acetate elutriant volume is slightly less than the produce volume in order to minimize acetate in either the displacement or tailing cuts. Preliminary demonstration of this procedure using a column containing 73 ml of Dowex-50W cation exchange resin loaded to 65% capacity gave greater than 99% uranium recovery at 150 g/l, 99% recovery at 180 g/l, and 97% recovery at 200 g/l. When the resin loading was reduced to 30% capacity, 97% uranium was recovered in the product at a concentration of 143 g/l. Lower resin loadings would result in even lower recoveries and concentrations. (auth)

583 CF-58-8-45
Oak Ridge National Lab., Tenn.
BELLOWS TYPE RESIN COLUMN EVALUATION—ORNL METAL RECOVERY PLANT. J. L. Whitten. Aug. 12, 1958. 17p. Contract [W-7405-eng-26]. $3.30 (ph OTS); $2.40(mf OTS).

A standard pilot plant resin column was fitted with a teflon expansion bellows. Resin bed compression was thus maintained under various chemical conditions. Hydraulic and experimental data were reported for these conditions at various flow rates through the resin bed. (auth)

584 IDO-14443
Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.
IDAHO CHEMICAL PROCESSING PLANT TECHNICAL PROGRESS REPORT FOR JANUARY THROUGH MARCH 1958. C. E. Stevenson. Sept. 15, 1958. 78p. Contract AT(10-1)-205. $2.25(OTS).

Recovery of enriched uranium from a Zircaloy fuel composition was successfully accomplished in plant operation by the hydrofluoric acid dissolution process. Adequate first cycle and over-all decontamination were achieved with low losses. Flowsheet modifications aimed to increase process capacity were studied. After 13 months' exposure at ambient temperature, corrosion of waste storage tank material was found to be less than anticipated. In TBP-Hexone processing of aluminum alloy fuels, process performance was satisfactory with recycle of second and third cycle raffinates for use as first cycle scrub. Waste volumes were significantly reduced by this means. Initial difficulty with plutonium contamination of the uranium product was overcome by stabilizing column operation, reducing acid carry-over to the second cycle, and adding ferrous ion as a third cycle reductant. Corrosion studies indicated that the use of titanium for aluminum nitrate concentration was satisfactory, and that this material would adequately resist plant decontamination reagents. Studies of mild steel corrosion by neutralized aluminum nitrate wastes were initiated. Validity of a parabolic rate law for aluminum dissolution in nitric acid was confirmed in laboratory studies. The continuous dissolver equation was tested with pilot plant data. In the development of new and modified zirconium alloy processes, it was determined that the hydrofluoric acid process could tolerate an increased percentage of uranium in the feed by increasing nitric acid usage. The feasibility of this modification from the corrosion standpoint will be determined. It appears that increased first cycle extraction capacity for such a process could be obtained by using TBP process equipment provided for aluminum fuels. Electrochemical studies indicated that the rate of dissolution of zirconium in nitric-hydrofluoric acid mixtures was controlled by the diffusion of hydrofluoric acid to the metal surface. Zircaloy-2 dissolved in such acid mixtures at substantially the same rate as zirconium, although in concentrated nitric acid tin was precipitated. The composition and stability of zirconium fluoride hydrates in equilibrium with nitric acid was determined. Conditions governing the TBP extraction of zirconium from nitrate and nitrate-fluoride systems were developed. A process uranium monitoring instrument was placed on test. Wear tests of graphite bearings in canned rotor pumps were continued and tests of ceramic bearings are planned. In studies of the fluid bed calcination process for aluminum nitrate wastes, silica gel was found to be superior to stainless steel as an absorbent for volatilized ruthenium in respect to capacity and vapor decontamination at higher velocities. In removing alumina particles from calciner off-gas by venturi scrubbing, increasing scrub rates at low gas velocity was less effective in improving efficiency than at high gas velocity. Heat transfer coefficients were measured for heating of the calciner bed by direct-fired tubes under pressure. Construction of a NaK heating system for the 2-foot square calciner is well along. A substantial portion of fine calcined alumina particles was found to dissolve in nitric acid. About half of the cesium contained in calcined alumina was volatilized at 1000°C. The process design of the demonstration calcining facility was tentatively determined. In other studies of forming solids from wastes, aluminum was quantitatively precipitated as the phosphate from dilute nitrate solution. Conditions for extraction of aluminum with acetylacetone were developed. A gel was formed with sodium silicate solution from zirconium contained in a nitric-hydrofluoric acid solution. In studies of a neptunium sample with the surface ionization mass spectrometer, neptunium-237 was readily identified and a small peak attributed to neptunium-236 was noted. A spectrometric means of determining boron in polyethylene tape was developed. Satisfactory uranium emission spectra were obtained using a hollow cathode tube. An analytical procedure for the determination of tin in zirconium-base alloys was devised. Neptunium was determined in plant process streams by TTA extraction. Neptunium was largely found in the first Hexone cycle raffinate. Determination of fluoride by pyrohydrolysis and alkalimetric titration was developed to yield a standard deviation of 0.9 percent. Analytical methods were also developed for determining nitrate, nitrite, and copper. (For preceding period see IDO-14430.) (auth)

585 ORNL-2469
Oak Ridge National Lab., Tenn.
DEVELOPMENT OF THE EXCER PROCESS. III. PREPARATION OF URANIUM TETRAFLUORIDE FROM URANYL CHLORIDE BY IRON REDUCTION AND PRECIPITATION. W. J. Neill and L. R. Higgins. Oct. 22, 1958. 12p. Contract W-7405-eng-26. $0.50 (OTS).

A flowsheet, based on laboratory-scale experiments, is presented for preparation of uranium(IV) fluoride solution by reduction of uranyl chloride with metallic iron. The reduction was rapid, with 95% efficiency for 100% reduction. Precipitation of $UF_4 \cdot 3/4\ H_2O$ from this solution with HF separated the iron from the uranium by a factor of 10^3. (auth)

586 AEC-tr-3307
PROBLEMS OF THE MARCOULE PLUTONIUM PLANT AND THEIR SOLUTIONS. R. Galley. Translated by C. E. Stevenson (Phillips Petroleum Co.) from Énergie nucléaire 2, 2-20(1958). 40p. $1.25(OTS).

Industrial problems presented in the extraction of plutonium from the fuel elements of the Marcoule Reactor G-1 are discussed. A general layout of the Marcoule plutonium plant is given. (W.D.M.)

587 AERE-Lib/Trans-792
ON THE THERMODYNAMICS OF EXTRACTION WITH TRIBUTYLPHOSPHATE. A. M. Rozen and L. P. Khorkhorina. Translated by V. Beak (U.K.A.E.A. Atomic Energy Research Establishment) from Zhur. Neorg. Khim. 2, 1956-69(1957). 22p.

A thermodynamic interpretation of the data on the separate and combined distribution of nitric acid and uranyl nitrate between an aqueous solution and TBP with a diluent is presented. The data from literature concerning the distribution of a number of actinide

elements in tracer concentrations are also examined, and the main laws of the extraction equilibria in which TBP takes part are discussed. (J.R.D.)

CONTROLLED THERMONUCLEAR PROCESSES

588 LA-2202

Los Alamos Scientific Lab., N. Mex.

MAGNETIC COMPRESSION OF SHOCK PREHEATED PLASMA. Edward M. Little and David B. Thomson. Apr. 1958. 44p. Contract W-7405-eng-36. $1.25(OTS).

In the experiments described, plasma was produced by the passage of planar shocks down the axis of a cylindrical discharge tube. The resulting plasma had a temperature of several electron volts. A strong axial magnetic field which compressed and adiabatically heated the shock preheated plasma was then applied to the cylindrical section of the discharge tube. One of the critical conditions of the experiment was that the preheated plasma had to have sufficient temperature and electrical conductivity so that the axial magnetic field would push on the plasma rather than diffuse through it, in the rise time of the magnetic field. The results presented indicate that this condition was achieved and that the adiabatic heating obtained from the magnetic compression stage was in reasonable agreement with theoretical predictions over most of the range of temperatures and pressures covered. (auth)

589

THE FORMATION OF THIN CARBON LAYERS IN A GLOW DISCHARGE FIRED IN BENZOL ATMOSPHERE. Arnold Heisen (Univ. of Munich). Ann. Physik 2, 23-35 (1958). (In German)

The formation velocity of layers, which originate on the electrodes and on small objects in the glow discharge, was followed by thickness measurements. The reference point for the origin mechanism of these films was given. The film formation is almost independent of whether the objects are found in the negative glow discharge or in the cathode drop space. The film formation was only little affected by variation of the electric potential. Therefore the various conjectures that the films are formed chiefly from hydrocarbon fragments in the gas space are incorrect. On the basis of this investigation it was assumed that the film-forming fragments are not in the gas space, but originate on the object surface. Incident energetic particles split adsorbed benzol molecules and they are converted to solid films. By means of a pressure stage apparatus such film producing particles could be detected. (tr-auth)

590

OBSERVATIONS ON COUPLED LOW PRESSURE DISCHARGES IN ARGON. Karl Rademacher and Karl Wojaczek (Deutsche Akademie der Wissenschaften, Berlin). Ann. Physik 2, 57-61(1958). (In German)

In cruciform discharge tubes, which were filled with pure argon at low pressures, several discharges coupled with each other with current intensities up to several amperes could be operated. An investigation was made to determine how far continuous layers could be suppressed in such a discharge and to what degree anode or cathode sided currents could influence a layer-free positive column. (tr-auth)

591

ARTIFICIALLY PRODUCED CONTINUOUS LAYERS IN ARGON LOW PRESSURE DISCHARGE. Karl Wojaczek (Deutsche Akademie der Wissenschaften, Berlin). Ann. Physik 2, 68-80(1958). (In German)

Above the Pupp limit current intensity i_G, artificial stationary continuous layers can be excited in the positive column of rare gas low pressure discharge by a periodic exterior perturbation of suitable frequency. The layers run from the anode direction up to the excitation position of the perturbation. The layer amplitude shows an exponential increase or decrease according to the current and intensity. This behavior was investigated thoroughly for argon at 1 Torr; the dispersion and the amplification of the artificial continuous layer was measured as a function of the frequency. The group velocity resulting from the dispersion in the natural stratification agrees with the propagation velocity of the Pekarek layer waves. By use of the relations derived by Pekarek, it was shown that the natural stratification frequency in the fixed range of the discharge parameters amounted to a fourth of the collision frequency of the electrons for ionized materials. The amplification shows a maximum in approximation of the stratification frequency, which was so large one approaches the limit current intensity, until the amplification in i_G is so large that self excitation occurs. (tr-auth)

592

THE FORMATION OF He_2^+ AND Ne_2^+ IN STATIONARY POSITIVE LOW PRESSURE COLUMNS. M. Pahl and U. Weimer (Max-Planck-Gesellschaft, Hechingen, Ger.). Z. Naturforsch. 13a. 753-7(1958) Sept. (In German)

The ion effusion streams from a stationary positive column in He and Ne glow discharges were measured with a discharge tube connected to a mass spectrometer. The effusion stream of a given ion is proportional to its formation velocity in the plasma. The formation rates of He_2^+/He^+ and Ne_2^+/Ne^+ were determined as a function of the total pressure (0.1 to 5 Torr) and the measuring curve was discussed. (tr-auth)

593

PROJECT SHERWOOD. THE U. S. PROGRAM IN CONTROLLED FUSION. Amasa S. Bishop. Reading, Mass., Addison-Wesley Publishing Company, Inc., 1958. 223p. $5.75.

This book is a brief account of the development of the United States program in controlled thermonuclear reactions from its inception in 1951 to the early part of 1958. The book is written mainly for those who have little or no familiarity with the subject, but who would like to become acquainted with this new and important field. Specifically, its purpose is to give the reader some insight into the origin of the program, the basic problems involved, the approaches being pursued in the United States, the difficulties encountered, the present status of the effort, and the outlook for eventual success. Effort has been made to present the material so that it can be followed by those with relatively little technical background. The few equations which appear have been relegated to footnotes and may be skipped at first reading with little loss of understanding. For those who wish to refresh their memories, an appendix provides a brief discussion of some of the basic principles of physics and nuclear structure essential for following the text. In addition, definitions of new or unusual terms are given in a glossary. The presentation is generally chronological. The first two chapters deal with fundamental matters common to all approaches being pursued. Chapters 3 through 8 present the basic principles of the major Sherwood projects and discuss the work carried out to the end of 1954. Chapter 9 is devoted to the important topic of stability,

which came to a head late in 1954. Developments in the program from 1955 to early 1958 are covered in Chapters 10 through 18. The last chapter reviews the present status of the effort and peers just a bit into the future. The charts in Appendix X tabulate the features and characteristics of important experimental models which have been built. (auth)

594

FIZIKA PLAZMY I PROBLEMA UPRAVLYAEMIKH TERMOYADERNIKH REAKTZIJ. (The Physics of Plasmas. Problems of Controlled Thermonuclear Reactions.) Volume I, II, III, and IV. M. A. Leontovich, ed. [Moscow], Institut Atomnoi Energii, Akademiia Nauk S.S.S.R., 1958. 1459p.

Articles reporting on the theoretical and experimental work done from 1951 to 1958 in the Institute of Atomic Energy of the USSR Academy of Science on the problem of controlled thermonuclear reactions and plasma physics are presented. Only those articles not previously published are included, and they are presented in chronological order. (J.S.R.)

595

THEORY OF THE MAGNETIC THERMONUCLEAR REACTOR. PART I. (Work completed in 1951). I. E. Tamm. pp. 3-19 in "The Physics of Plasmas, Vol. I." (In Russian)

In this basic article on a magnetic thermonuclear reactor, the motion of a charged particle in crossed fields, kinetic equations and the first approximation theory with neglect of collisons, the second approximation theory and the role of collisions, heat conductivity and the viscosity of the plasma, and an orientating calculation of a small model of a controlled thermonuclear reactor with heating at a temperature discontinuity are discussed. (J.S.R.)

596

THEORY OF THE MAGNETIC THERMONUCLEAR REACTOR. PART II. (Work completed in 1951). A. D. Sakharov. pp. 20-30 in "The Physics of Plasmas, Vol. I." (In Russian)

Further problems considered in the theory of a magnetic thermonuclear reactor include the bremsstrahlung of thermonuclear reactions, calculation of a large model with its critical radius and boundary phenomena, the extent of magnetization, optimal construction and productivity with respect to active species, drift in a non-homogeneous magnetic field with increased current and induction stabilization, and the problem of the instability of the plasma. Practical details as to the temperatures and alloys to be used and the dimensions of the apparatus are also given. (J.S.R.)

597

THEORY OF THE MAGNETIC THERMONUCLEAR REACTOR. PART III. (Work completed in 1951). I. E. Tamm. pp. 31-41 in "The Physics of Plasmas, Vol. I." (In Russian)

The problem of drift and heat conductivity of the plasma in a toroid in the presence of a stabilized current is considered. Formulas are given which permit the calculation of the heat conductivity as a function of the field of the stabilized current flowing in the plasma and of the field of the windings on the toroid. (J.S.R.)

598

INVESTIGATION OF THE HEATING OF HYDROGEN PLASMA IN SMALL TOROIDAL SYSTEMS. (Work completed in 1951). A. M. Andrianov, O. A. Bazilevskaya, et al. pp. 42-65 in "The Physics of Plasmas, Vol. I." (In Russian)

The physical basis of the optical and electrical methods of measuring some of the parameters of the plasma is described. The experimental set-up is given and also the technique of carrying out the measurements. The more important experimental data are given, and the results obtained are discussed. (TCO)

599

QUESTIONS ASSOCIATED WITH THE DRIFT OF PARTICLES IN A TOROIDAL MAGNETIC THERMONUCLEAR REACTION CHAMBER. (Work completed in 1951). G. I. Budker. pp. 66-76 in "The Physics of Plasmas, Vol. I." (In Russian)

An investigation is made of the drift of particles in a non-homogeneous magnetic and electric field. An evaluation is made of the heat conductivity in a torus on stabilization of the drift by a magnetic field of a longitudinal current and by some other methods. The considerations presented permit conclusions concerning the insufficiency of compensation of the drift by weak longitudinal currents. An evaluation shows that for realization of a thermonuclear reaction it is necessary that the field of the stabilizing current be of the same order of magnitude as that of the basic field. In addition to this, it is necessary to create additional fields associated with the walls of the chamber which would hold the plasma as a whole within the torus. (TCO)

600

THE INFLUENCE OF THE VIBRATIONS OF THE PLASMA ON ITS ELECTRICAL AND THERMAL CONDUCTIVITY. (Work completed in 1951). B. I. Davydov. pp. 77-88 in "The Physics of Plasmas, Vol. I." (In Russian)

The influence of the vibrations of the plasma on the motion of its electrons and ions and on its heat conductivity was evaluated by assuming that the vibration intensity corresponds to the heat equilibrium. It is well known that arbitrary order currents in the plasma lead to an artificial excitation of the vibrations. In addition, the intensities may be considerably greater than that given by the Raleigh-Jeans formula. (TCO)

601

IGNITION OF AN ELECTRODELESS DISCHARGE. (Work completed in 1951). B. I. Davydov. pp. 89-94 in "The Physics of Plasmas, Vol. I." (In Russian)

After a general discussion of the difference between ignition in a discharge with electrodes and one without electrodes, the cases of ignition without a circular magnetic field and then one in the presence of a constant longitudinal circular magnetic field are considered. (TCO)

602

THEORY AND EXPERIMENTS ON THE IGNITION OF AN ELECTRODELESS DISCHARGE IN A MAGNETIC FIELD. (Work completed in 1951). A. M. Andrianov and S. M. Osovets. pp. 95-109 in "The Physics of Plasmas, Vol. I." (In Russian)

The theory of the breakdown in the absence of a magnetic field and in a torus or the presence of a longitudinal magnetic field is discussed. The time dependence of the breakdown is considered. The breakdown in hydrogen was studied experimentally in a glass tube 4 cm in diameter and bent in the shape of a torus with a diameter of 50 cm. The electrical field inside the torus is produced by a discharge across a copper coil placed in the middle of the torus. To increase the connection between the copper windings and the gas, an iron insert with a 150 cm cross section was placed inside the windings. The results are tabulated as

functions of pressure and potential. The experiments agree within 30% of theory. (J.S.R.)

603

FORCES ACTING ON A LINEAR CURRENT WHICH IS WITHIN CONDUCTING CYLINDRICAL TUBES. (Work completed in 1951). M. A. Leontovich. pp. 110-14 in "The Physics of Plasmas, Vol. I." (In Russian)

In connection with the question of stabilizing the currents with the help of a conducting tube surrounding it, several elementary formulas for forces acting on the current were derived. (TCO)

604

COMPRESSION OF A PLASMA UNDER THE ACTION OF ITS OWN MAGNETIC FIELD. (Work completed in 1951). S. I. Braginskii. pp. 115-21 in "The Physics of Plasmas, Vol. I." (In Russian)

Preliminary results are given of the study of the stationary problem of the compression of a plasma in an infinitely long pipe. The plasma is considered completely ionized. The external magnetic field is absent. A more detailed study of the non-stationary process was published in Zhur. Eksptl'. i Teoret. Fiz. 33, 645 (1957). (TCO)

605

THE BETATRON METHOD OF HEATING PLASMA TO HIGH TEMPERATURES. (Work completed in 1951). G. I. Budker. pp. 122-9 in "The Physics of Plasmas, Vol. I." (In Russian)

A new method of heating the plasma to high temperatures—the so-called betatron method of heating—is based on the fact that by increasing the magnetic field the temperature of the plasma increases. The results are compared with the previously proposed method of heating with the help of a longitudinal electric field. The problem is solved for the first model: an infinite straight tube with a magnetic field directed along the axis. (TCO)

606

THE VELOCITY OF EQUILIBRATION OF THE TEMPERATURES OF CHARGED PARTICLES IN A PLASMA. (Work completed in 1951). V. I. Kogan. pp. 130-7 in "The Physics of Plasmas, Vol. I." (In Russian)

The velocity of the energy exchange between two degrees of freedom of a gas of charged particles present at one temperature and a third degree of freedom of the same gas present at another temperature is calculated and applied to the problem of the betatron heating of plasma. The velocity of the temperature equalization of charged particles of two types for any ratio of their masses is also calculated. (J.S.R.)

607

THE THEORY OF THE TEMPERATURE JUMP AT THE BOUNDARY OF A PLASMA IN A MAGNETIC FIELD. (Work completed in 1951). D. N. Zubarev and V. N. Klimov. pp. 138-61 in "The Physics of Plasmas, Vol. I." (In Russian)

The temperature discontinuity at the boundary of a magnetized plasma was examined with consideration of the processes of ionization excitation and charged transfer of atoms in the layer near the wall. It is shown that the temperature discontinuity can take place under conditions of the large model of the controlled thermonuclear reactor (the mean free path of neutral particles being small compared to the dimensions of the system) for values of the heat flow to the walls and for the density of particles in the center of the system of the order of magnitude of the technical model. (TCO)

608

DIELECTRIC CONSTANT OF A HIGH TEMPERATURE MAGNETIZED PLASMA AND THE EVALUATION OF THE RADIANT HEAT CONDUCTIVITY. (Work completed in 1951). V. M. Galitskii and A. B. Migdal. pp. 161-71 in "The Physics of Plasmas, Vol. I." (In Russian)

An expression is found for the dielectric constant of a plasma situated in a magnetic field at high temperatures when there are relativistic effects present. On the basis of the imaginary part of the dielectric constant, an evaluation is made of the radiant thermal conductivity. The radiant thermal conductivity is found to be smaller than the heat conductivity produced by the particles. (TCO)

609

THE ELECTRON TEMPERATURE DEPENDENCE OF THE SPECTRUM OF THE BREMSSTRAHLUNG OF A PLASMA. (Work completed in 1951). V. I. Kogan and A. B. Migdal. pp. 172-7 in "The Physics of Plasmas, Vol. I." (In Russian)

Approximate expressions are derived for the spectral distribution of the intensity of the bremsstrahlung in its dependence on the electron temperature of the hydrogen plasma (in the Born and quasi-classical regions of temperature). The possibility is discussed of using these expressions for the determination of the electron temperature using experimental data. (TCO)

610

THE FLOW OF PARTICLES AND HEAT ACROSS A STRONG MAGNETIC FIELD IN A COMPLETELY IONIZED TWO-TEMPERATURE PLASMA. (Work completed in 1951). S. I. Braginski. pp. 178-85 in "The Physics of Plasmas, Vol. I." (In Russian)

The transverse flow of particles and heat in a strong magnetic field for different temperatures of electrons and ions was calculated. The results agree with those obtained by Zubarev and Klimov. (J.S.R.)

611

THE PHYSICAL PHENOMENA IN THE PROCESS OF THE IGNITION OF A DISCHARGE FOR INCOMPLETE IONIZATION. (Work completed in 1952). S. I. Braginskii and G. I. Budker. pp. 186-206 in "The Physics of Plasmas, Vol. I." (In Russian)

A preliminary report on the theoretical investigation of the initial stages of a large current discharge in hydrogen is presented. The problem is set up, and a series of individual questions are analyzed, but the whole problem is not solved. The breakdown and formation of a quasi-neutral plasma, the magnetization of electrons and the skin effect, and forbidden radiation are the topics discussed. (J.S.R.)

612

THE STABILITY OF A FLEXIBLE CONDUCTOR IN A LONGITUDINAL MAGNETIC FIELD. (Work completed in 1952). M. A. Leontovich and V. D. Shafranov. pp. 207-13 in "The Physics of Plasmas, Vol. I." (In Russian)

The problem of the stability of the form of a non-elastic linear conductor of a circular cross section with current in a longitudinal magnetic field is examined. It is well known that the field of the current produces instabilities with respect to the distortion of the form of the conductor. It is shown that if the external longitudinal field is sufficiently large, it leads to stability. The minimal value necessary for this field exceeds the value of the field of the current on the boundaries of the conductor. The problem is solved with the assumptions that the conductor is ideal and the distortion of the form

of the conductor is not large. Under these assumptions it is easy to find a field and a distribution of currents necessary for calculating the forces arising by distorting the conductor. (TCO)

613
AN ELECTRICAL BREAKDOWN IN A GAS IN THE PRESENCE OF A STRONG EXTERNAL MAGNETIC FIELD VARIABLE IN TIME. (Work completed in 1952). G. I. Budker. pp. 214-21 in "The Physics of Plasmas, Vol. I." (In Russian)

The magnetic field affects the breakdown for the most part in three respects. It decreases the transverse coefficient of diffusion, causes the drift of electrons to the center, and weakens the transverse conductivity so that the heating of electrons by the induced electric field can be neglected. The breakdown is produced by the external longitudinal electric field. In a magnetic field the conditions of the breakdown turn out to be considerably easier than without it, especially in those cases when the magnetic field increases in time. A completely different dependence is found on the density which considerably facilitates the breakdown at small densities. The discharge in an infinite straight pipe and in a finite straight pipe is examined. The problem of the discharge in a torus can be resolved to a problem in a straight tube with a sufficiently rapid growing magnetic field. (TCO)

614
THE MAGNETIC FIELD OF A LINEAR CURRENT SURROUNDED BY AN IDEALLY CONDUCTING CYLINDER WITH A CUT. (Work completed in 1952). M. A. Leontovich. pp. 222-8 in "The Physics of Plasmas, Vol. I." (In Russian)

The presence of a cut decreases the force near it which pulls the current toward the center of the cylinder. (TCO)

615
INVESTIGATION OF THE AXIAL REGION OF A PLASMA PINCH. (Work completed in 1952). S. I. Braginskii. pp. 229-33 in "The Physics of Plasmas, Vol. I." (In Russian)

The region along the cylindrical axis of a completely ionized plasma in which there is a current is considered. The magnetic forces of this current compress the plasma equilibrating its pressure. Close to the axis where the magnetic field passes through zero the trajectories of the particles have the form of snakes and not circles, as in other parts of the pinch. The region near the axis is investigated with the help of microscopic equations. (J.S.R.)

616
A PIEZO-ELECTRIC METHOD OF INVESTIGATING A STRONG GAS DISCHARGE. (Work completed in 1952). V. S. Komel'kov and V. I. Sinitsyn. pp. 234-42 in "The Physics of Plasmas, Vol. I." (In Russian)

A piezo-electric method is described for the registration of the form and magnitude of pressure pulses passing to the walls of the discharge chamber in the process of development and passage of a gas discharge. This method permits the establishment of phase relations between the discharge current and the pressures on the walls of the chamber and an evaluation of the energy of the plasma particles. (TCO)

617
THERMONUCLEAR REACTION IN A POTENTIAL HOLE OF A NEGATIVE CHARGE. (Work completed in 1952). G. I. Budker. pp. 243-8 in "The Physics of Plasmas, Vol. I." (In Russian)

The volume filled with electrons represents a potential hole for ions in which, generally speaking, there may be thermonuclear reactions. However, electromagnetic radiation of the electrons is considerably greater than the energy evolved by the reaction. Therefore, such a system is not a reactor with a positive yield of energy. (TCO)

618
STATIONARY CONDITIONS OF A MAGNETIC THERMONUCLEAR REACTOR. (Work completed in 1952). D. N. Zubarev and V. N. Klimov. pp. 249-88 in "The Physics of Plasmas, Vol. I." (In Russian)

A detailed investigation is made of the stationary conditions of a magnetic thermonuclear reactor with consideration of bremsstrahlung and nuclear reactions in the DD and DT system. (TCO)

619
THE INSTABILITY OF A PLASMA CYLINDER. (Work completed in 1952). B. A. Trubnikov. pp. 289-98 in "The Physics of Plasmas, Vol. I." (In Russian)

The stability conditions of a stationary cylindrical column of a completely ionized plasma with a longitudinal current uniformly distributed in cross section are examined. It is shown by a method of small perturbations that the axially symmetrical deformations having a periodic form along the axis of contraction rise exponentially in orders of time $t \sim (a^{\chi} z/v)^{1/\chi}$ where a is the non-excited radius of a cylinder, χ is the wave length of the perturbation, and v is the heat velocity of the ions. This can lead to a complete disruption of the current in the circuit. (TCO)

620
THE PLASMA PINCH WITH HEAT LOSS AT THE ELECTRODES. (Work completed in 1953). S. I. Braginskii and V. D. Shafranov. pp. 3-19 in "The Physics of Plasmas, Vol. II." (In Russian)

An attempt is made to consider the plasma pinch with electrodes. The presence of electrodes leads to the fact that physical quantities change along the axis in contrast with what must take place in an infinite column. It is easy to show that in the case when the inertia and the viscosity of the plasma can be neglected and when the proper electric field of the column is small with respect to the magnetic field, the pressure, the current density, and the magnetic field in the pinch do not change along the axis. (TCO)

621
THE PROCESSES IN A PLASMA COLUMN WITH RAPID INCREASE OF CURRENT. (Work completed in 1951). S. I. Braginskii and A. B. Migdal. pp. 20-5 in "The Physics of Plasmas, Vol. II." (In Russian)

A short examination is made of the physical processes essential in a powerful pulse discharge: ionization, skin effect, motion of the ions toward the axis and their entrainment of the neutral gas, the convergent shock wave and cumulation on the axis, the compression of the plasma column with a consideration of the increase of the moving mass, and temperature of the ions and atoms. The experimental investigations of a massive impulse discharge showed that with a rapid increase of the current in a cylindrical discharge chamber a plasma column is formed compressed toward the axis. A qualitative theory of the compression was developed by M. A. Leontovich and S. N. Osovets (Atomnaya Energ. 1, 81(1956)), on the basis of a hypothesis of the inertial character of this process. These results agree well with experiments. The present work is an attempt for a qualitative investigation of the basic phenomena taking place in the process of formation of a plasma column and some refinements of the physical picture of its compression. (TCO)

622

THE PLASMA PINCH IN THE PRESENCE OF A LONGITUDINAL MAGNETIC FIELD. (Work completed in 1953). S. I. Braginskii and V. D. Shafranov. pp. 26-80 in "The Physics of Plasmas, Vol. II." (In Russian)

An investigation is made of the plasma column in the presence of an internal longitudinal field of a magnet. A preliminary presentation is given of the basic results of a pinch without a longitudinal field. Equations describing the pinch are given, and the relation of the pinch to the temperature is discussed. The rapid and slow processes are described. Heat balance equations and the change of the pinch radius with time are presented. The heating and compression of the plasma and a pinch with heat losses are considered. Auto modeling conditions are described. The conditions for nonrupture from the walls and a system of equations in the presence of a longitudinal field are given. The stationary case, rapid processes, and auto-modeled conditions are considered. The article concludes with a discussion of the pinch produced by a longitudinal field. (TCO)

623

PASSING OF LARGE CURRENTS THROUGH A PLASMA IN THE PRESENCE OF A LONGITUDINAL MAGNETIC FIELD. (Work completed in 1953). L. A. Artsimovich. pp. 81-6 in "The Physics of Plasmas, Vol. II." (In Russian)

The behavior of a plasma pinch produced by rather large currents passing through a plasma in the case when the whole system is in a constant field or almost constant field is considered. It is assumed that one can neglect the gas kinetic pressure of the plasma (rapid pulse process). The conductivity of the plasma is considered infinite. (TCO)

624

MAGNETIC CURRENT IN A COMPRESSING CYLINDER. (Work completed in 1953). L. A. Artsimovich. pp. 87-100 in "The Physics of Plasmas, Vol. II." (In Russian)

Processes in a compressed conducting cylinder present in a magnetic field are examined. Formulas are given for several cases of the change of the cylinder radius as a function of time. In addition to this, an analysis is given of the experimental data and the possibility of determining the conductivity of the cylinder. (TCO)

625

ANALYSIS OF THE EQUATIONS OF THE COMPRESSION OF THE PINCH IN THE PRESENCE OF AN EXTERNAL MAGNETIC FIELD. (Work completed in 1954). L. A. Artsimovich. pp. 101-8 in "The Physics of Plasmas, Vol. II." (In Russian)

An analysis is made of the equations describing the compression of a gaseous column in the presence of a constant longitudinal magnetic field. The case is examined when the magnetic time is small compared to the time of the current change, and approximate equations are determined for the radius of the pinch. (TCO)

626

THE YIELD OF THERMONUCLEAR REACTIONS. (Work completed in 1953). V. I. Kogan. pp. 109-29 in "The Physics of Plasmas, Vol. II." (In Russian)

Several questions dealing with the yield of the DD reaction are investigated. The region of the applicability of the simple analytical expression for the yield (the Bethe-Atkinson formula) is studied. The influence of the "cutting of the tails" of the Maxwellian distribution of ion velocities is considered. For a given energy introduced into the system, the optimum number of particles for a polytropic law of compression of the reacting plasma is derived. The optimum linear number of particles in a system with a plasma current working with an auto-modeling condition is studied for a given current with consideration of a temperature difference of the ions from the electrons. (TCO)

627

STABILITY OF A PLASMA PINCH IN THE PRESENCE OF A LONGITUDINAL MAGNETIC FIELD AND A CONDUCTING ENVELOPE. (Work completed in 1953). V. D. Shafranov. pp. 130-43 in "The Physics of Plasmas, Vol. II." (In Russian)

Investigation of the stability of a plasma pinch in the presence of a longitudinal magnetic field shows that there are two possible methods of stabilization of the column with the help of a longitudinal magnetic field: (1) stability by means of internal frozen-in longitudinal fields greater than the external field in the presence of the envelope and (2) stability in the presence of a strong external longitudinal field. In the first case, there is a region of stability with respect to arbitrary excitation. In the second case, a calculation made in the linear approximation shows that not all forms of excitation can be stabilized. It is possible, however, to stabilize simultaneously the more dangerous excitation of the forms of attractions and perturbations at which the center of the axis is displaced from its equilibrium position. (TCO)

628

THE STABILITY OF A PLASMA CYLINDER IN AN EXTERNAL MAGNETIC FIELD. (Work completed in 1953). T. F. Volkov. pp. 144-9 in "The Physics of Plasmas, Vol. II." (In Russian)

The question of the stability with respect to perturbations of a type of attractions of the plasma cylinder with a current in an external field directed along the axis is investigated. It is assumed that the current is distributed uniformly in cross section. It is shown that for a sufficiently large magnetic field the perturbations of the type examined are stable. (TCO)

629

DISTRIBUTION OF THE INTENSITY OF THE NEUTRON RADIATION ALONG THE AXIS OF A STRAIGHT TUBE FOR A STRONG PULSE DISCHARGE IN DEUTERIUM. (Work completed in 1954). N. A. Borzunov and D. V. Orlinskii. pp. 150-64 in "The Physics of Plasmas, Vol. II." (In Russian)

The intensity of the neutron radiation of a strong pulse discharge in deuterium increases linearly with increase of the initial potential (from 30 to 50 kv). In addition to this, the neutron radiation of the discharge exceeds the cosmic background in the range of $N = 1.5 \times 10^{17}$ to 3.5×10^{18} atoms per 1 cm of length. In determining the distribution curve, one does not obtain a reproducibility of results. This is evidence of the statistical character of the phenomena taking part in the discharge. Results of investigation of the experiments in a broader tube (with a distance of the counters to the axis of 20.5 cm) give a basis for the conclusion that the neutron radiation is not distributed uniformly along the length but is concentrated in definite, rather small, regions which may be several in number. In other words, the neutron radiation in the discharge has a local character and is concentrated in a region of the order of diameter of a discharge tube. (TCO)

630

MECHANISM OF THE OBSERVED NEUTRON EMISSION. (Work completed in 1954). S. M. Osovets.

pp. 165-9 in "The Physics of Plasmas, Vol. II." (In Russian)

In the process of investigating the phenomena which arise when powerful pulse discharges are made in deuterium, it was found that under definite conditions in such a discharge there is a noticeable neutron emission which is accompanied usually with the emission of hard x-ray quanta. In the present note speculations are presented on the basis of which one can make the conclusion that under these conditions the mechanism of neutron emission cannot be explained in principle by processes associated with the course of thermonuclear reactions. It is shown that in a system of nuclear reactions $D + D = He^3 + n$ the observed intensities may take place only because of interactions of deuterons with energies many times greater than the temperature of the plasma. Several estimates are presented for a typical installation on which one can observe clearly the neutron radiation. (TCO)

631

INVESTIGATION OF A POWERFUL ELECTRIC DISCHARGE IN DEUTERIUM. (Work completed in 1954). V. S. Komel'kov, T. I. Morozova, and Yu. V. Skvortsov. pp. 170-84 in "The Physics of Plasmas, Vol. II." (In Russian)

Oscillographs are given for a discharge in deuterium for C = 24 to 36 mkf, I_{max} = 650 ka, and diameter of the chamber 630 mm for the pressure range of 0.0025 to 0.1 mm mercury and for initial potentials V_0 = 42 to 100 kv. Several "peculiarities" in the current were observed. The integral yield of neutrons was registered in its dependence on C, V_0, P_0. The moment of the appearance and the length of the neutron pulses were determined. An investigation was made of the x radiation accompanying the neutron emission. (TCO)

632

INVESTIGATIONS OF A PULSE DISCHARGE IN GASES FOR CURRENT STRENGTH OF 500 KA. (Work completed in 1956). A. N. Andrianov, O. A. Bazilevskaya, and Yu. G. Prokhorov. pp. 185-211 in "The Physics of Plasmas, Vol. II." (In Russian)

Results are presented on the measurement of the distribution of the magnetic and electric fields within a powerful gas discharge. These measurements are part of a large cycle of work for investigating pulse discharges in gases for high current strength. The basic goal was the investigation of discharges in deuterium, but in addition to this, discharges in hydrogen, helium, argon, and xenon were also investigated. (TCO)

633

MEASUREMENT OF THE CONDUCTIVITY OF THE PLASMA FOR THE PASSAGE OF CURRENT FOR A LONG TIME. (Work completed in 1954). V. D. Kirillov. pp. 212-25 in "The Physics of Plasmas, Vol. II." (In Russian)

The methods and experimental results of investigating a powerful (for currents up to 95 ka) low frequency (f is equal to 270 cps) discharge in deuterium are described. Oscillographs are given of the voltage for discharges with a longitudinal magnetic field and without it, for curves of the change of the interelectrode resistance as a function of time, high-speed photographs for the potential at the condensors equal to 6 kv, and the curves for the distribution of the potential along the axis of the discharge tube. The experimental results with low frequency gas discharge showed that the discharge begins in the center of the camera, and the plasma pinch retaining its stability expands toward the walls. During the time of expansion the total resistance of the gas discharge drops. At the end of the "plateau," which corresponds to the expansion, the conductivity stops increasing, reaching the value of 5 to 15 × 10^{13} CGSE independent of the conditions. With increase of dI/dt, the length of the plateau decreases. The potential of the electric field is strongly inhomogeneous along the axis of the chamber. (TCO)

634

THE THEORY OF BREMSSTRAHLUNG FOR NONRELATIVISTIC RADIATION. (Work completed in 1954). V. V. Babikov. pp. 226-37 in "The Physics of Plasmas, Vol. II." (In Russian)

Corrections were obtained to the important members of the Born and quasi-classical approximation for the spectral distribution of the intensity of the bremsstrahlung of electrons in a Coulomb field. (TCO)

635

A PLASMA DISCHARGE IN AN ELECTRO-MAGNETIC FIELD. (Work completed in 1953). S. M. Osovets. pp. 238-41 in "The Physics of Plasmas, Vol. II." (In Russian)

The basis of the theory of an electrodeless gas discharge of a definite configuration is presented. In a discharge of this type, conditions may be realized which are analogous, to a certain degree, to those which occur in the acceleration of electrons in a vacuum betatron. Just as in the betatron there is a possibility of increasing the electrons. In the gas discharge considered the plasma may be heated. (TCO)

636

INVESTIGATION OF A GAS DISCHARGE IN A UNICONNECTED REGION. (Work completed in 1955). S. M. Osovets, Yu. F. Petrov, and N. I. Shchedrin. pp. 242-63 in "The Physics of Plasmas, Vol. II." (In Russian)

Results are given of the investigation of a gas discharge in a uni-connected region rising under the action of a variable magnetic field. It is shown that in this case a plasma pinch is formed which is compressed to the center of the discharge vessel. The theoretical investigations show that the choice of a special form of a magnetic field may give a region in which such a plasma pinch is in a state of equilibrium. The investigations were carried out on a system with a magnetic field satisfying these conditions. In this system, hard x radiation was observed (several hundredths kev) indicating the fundamental possibility of obtaining in installations of this type a betatron acceleration of electrons without preliminary injection. (TCO)

637

INVESTIGATION OF A RING GAS DISCHARGE IN A TRANSVERSE MAGNETIC FIELD. (Work completed in 1955). Yu. F. Nasedkin. pp. 264-82 in "The Physics of Plasmas, Vol. II." (In Russian)

With the purpose of decreasing the influence of the active resistance of a gas pinch on the course of the discharge, the installation described was constructed. It insures the necessary form of the magnetic field and has a small inductance equal to 0.15 micro-henries and a large coefficient of coupling (K = 0.35). The distribution of the secondary current in the volume of the chamber was studied. The results of the experiments give a basis for considering that in the course of the first half period, the secondary current is torn away from the walls and situated near the calculated stable orbit. In the region of the maximum primary current, the secondary current is torn away from the orbit and moves toward the center as a unit. In the

second and subsequent semi-periods, the discharge fills the whole volume. (TCO)

638

RELATIVISTIC PLASMA IN VARIABLE FIELDS. (Work completed in 1953). S. T. Belyaev and G. I. Budker. pp. 283-329 in "The Physics of Plasmas, Vol. II." (In Russian)

An investigation is made of the behavior of a relativistic gas of charged particles present in a strong constant-in-time and, generally speaking, non-homogeneous magnetic and electric field with an exciting variable electro-magnetic field, the frequency of which is much greater than the frequency of collisions so that one can neglect the latter. (TCO)

639

KINETIC EQUATION FOR AN ELECTRON GAS FOR RARE COLLISIONS. (Work completed in 1954). G. I. Budker and S. T. Belyaev. pp. 330-54 in "The Physics of Plasmas, Vol. II." (In Russian)

A method of simplifying kinetic equations for rare collisions is proposed. A corresponding equation is found for a relativistic gas which can be used for the investigation of a stationary state of a stabilized electron beam. (TCO)

640

THERMONUCLEAR REACTIONS IN A SYSTEM WITH MAGNETIC MIRRORS. (Work completed in 1954). G. I. Budker. pp. 3-31 in "The Physics of Plasmas, Vol. III." (In Russian)

Physical principles and preliminary calculations are presented in the investigation concerning the methods proposed for realizing the thermonuclear reaction in a straight cylinder closed at the ends with magnetic mirrors. A method is investigated for igniting the discharge in a high vacuum and for heating the plasma with the help of a magnetic piston. In addition to this, an examination is made of the question of direct transformation of nuclear energy into electrical energy. (TCO)

641

SEVERAL PROBLEMS ASSOCIATED WITH SPATIAL STABILITY OF A RING CURRENT IN PLASMA. (Work completed in 1951). G. I. Budker. pp. 32-40 in "The Physics of Plasmas, Vol. III." (In Russian)

This investigation considers several problems associated with the stability of the ring current in plasma. Only stabilities associated with slow changes are investigated. The times of changes are such that equilibrium is able to be established for temperature and density. Rapid changes and others with so-called inertial times are not investigated. (TCO)

642

MULTI-QUANTA RECOMBINATION IN AN IONIZED GAS. (Work completed in 1955). S. T. Belyaev and G. I. Budker. pp. 41-9 in "The Physics of Plasmas, Vol. III." (In Russian)

With the help of a classical kinetic equation, the process of electron transition to the ground level of the atom was investigated using multiple collisions and emission of small quanta. The method of approximate kinetic equations for rare collisions was used.

643

KINETIC EQUATIONS FOR DILUTE GASES IN STRONG FIELDS. (Work completed in 1955). S. T. Belyaev. pp. 50-65 in "The Physics of Plasmas, Vol. III." (In Russian)

A method is developed for obtaining approximate kinetic equations for dilute ionized gases in strong external fields. The small parameter of approximation is the ratio of the period of proper vibrations of the particles in an external field to the time of the mean free path. The approximate equation has the form of the Fokker-Planck equation with a smaller number of variables. (TCO)

644

THE KINETICS OF AN IONIZED GAS IN A STRONG MAGNETIC FIELD. (Work completed in 1955). S. T. Belyaev. pp. 66-85 in "The Physics of Plasmas, Vol. III." (In Russian)

An ionized gas in a strong magnetic field is considered as an ensemble of Larmor rings. A kinetic equation is obtained for the distribution function of the Larmor rings. Its solution is examined in the hydrodynamic approximation. The coefficient of the electron-ion diffusion is calculated for a uniform magnetic field. In a homogeneous field the currents are found, if one does not consider collisions. (TCO)

645

RADIANT HEAT LOSSES OF A DENSE HIGH TEMPERATURE PLASMA. (Work completed in 1955). V. V. Babikov and V. I. Kogan. pp. 86-98 in "The Physics of Plasmas, Vol. III." (In Russian)

Because of its application to the problem of heating dense or condensed media, a calculation is made of the heat loss of a layer of plasma in consequence of the bremsstrahlung for arbitrary degrees of its transparency. The transition from "transparent" emission to black emission is investigated. The question of radiant opaqueness and radiant heat losses of a dense high temperature plasma is investigated for those values of its density, temperature, and size when one of two limiting cases is in general not applicable — one, the free yield of the bremsstrahlung for the whole volume of the plasma and, two, the black radiation from the surface of the plasma is strongly forbidden for the radiation in it. Investigation of this question has a significant meaning for the problem of heating dense or condensed media to temperatures at which thermonuclear reactions can be excited. The problem is that on one hand the heat loss by the mechanism of bremsstrahlung is the main component in the complete heat loss of the plasma for a wide range of changes of the parameters, and on the other hand there is a transition from the case of a transparent medium to a case of "black" medium in a considerable portion of the designated range. Inasmuch as under the conditions examined (density of the plasma 10^{19} to 10^{23} cm^{-3} interval and temperature 10 ev to 1 kev interval) the plasma is practically completely ionized, the basic mechanism of the absorption of radiation, due to the opacity of the plasma, is the bremsstrahlung (photo effect on free electrons). (TCO)

646

RECOMBINATION RADIATION OF A HYDROGEN PLASMA. (Work completed in 1956). V. I. Kogan. pp. 99-103 in "The Physics of Plasmas, Vol. III." (In Russian)

A calculation is made of the complete intensity of recombination radiation of a dilute hydrogen plasma as a function of the electron temperature (with consideration of recombination at excited levels). A comparison is made of this quantity with the intensity of the bremsstrahlung. A figure is given in which it is shown that the intensity of the recombination radiation decreases linearly as a function of the electron temperature while the radiation due to bremsstrahlung increases with electron temperature giving for the total losses a minimum at a temperature of about 30 ev. (TCO)

647
ELECTROMAGNETIC WAVES IN A RELATIVISTIC PLASMA IN THE PRESENCE OF A MAGNETIC FIELD. (Work completed in 1956). B. A. Trubnikov. pp. 104–13 in "The Physics of Plasmas, Vol. III." (In Russian)

The relativistic tensor for the dielectric susceptibility of a plasma which is situated on a homogeneous magnetic field was obtained. The heat motion of the electrons is described by a Maxwell (relativistic) distribution. Collisions are considered rare. With the help of the dispersion equation the propagation of waves of the form $\exp[i(kr - at)]$ was investigated. For frequencies $\omega \gg eH/mc$, the radiation ability of the medium and the absorption coefficients of "ordinary" and "non-ordinary" waves were calculated. (TCO)

648
THE DISTRIBUTION FUNCTION OF ELECTRONS IN A PLASMA SITUATED IN A MAGNETIC FIELD. (Work completed in 1956). V. S. Kudryavtsev. pp. 114–20 in "The Physics of Plasmas, Vol. III." (In Russian)

A distribution function for electrons is calculated for a two-temperature plasma for the case when the electrons by collisions obtain energy from the ions at high temperature and emit it by motion in a magnetic field. The stationary process is examined and the plasma is considered completely transparent. (TCO)

649
MAGNETIC EMISSION OF A LAYER OF PLASMA. (Work completed in 1957). B. A. Trubnikov and A. E. Bazhanova. pp. 121–47 in "The Physics of Plasmas, Vol. III." (In Russian)

Calculation is made of the magnetic decelerating radiation of a plane layer of plasma situated in an external magnetic field parallel to the boundaries of the layer. The weakly-relativistic energies of the electrons are investigated. Calculations are carried out for two forms of energy distribution of electrons — Maxwell and a cut-off Maxwell distribution. It is shown that the degree of forbiddeness of the thermonuclear reactor DD is reached only for large sizes of the layer which lie within the limits of technical realization. The size of the layer (from 3.9 meters to 2.1 kilometers) necessary for the self-sustainment of the DD reaction in installations, where in the plasma there is a considerable magnetic field, characterizes the difficulties of realizing such systems. For the reaction of a DT mixture there is a region of temperatures from 7 to 45 kev where the production of nuclear energy on charged particles is greater than the losses by radiating emission. For decreasing the losses by magnetic radiation, special measures must be taken, and it is possible to use mirrors which turn the radiant energy back into the plasma. It is noted that magnetic radiation losses are absent in systems where the containment of the plasma is realized by high frequency external fields which do not penetrate within the plasma. (TCO)

650
THE PROBLEM OF THE DECOMPOSITION OF AN ARBITRARY SHOCK IN A CONTINUOUS MEDIUM. (Work completed in 1956). T. F. Volkov. pp. 148–52 in "The Physics of Plasmas, Vol. III." (In Russian)

The particular case of the breakdown of an arbitrary shock in a continuous medium was investigated with the purpose of obtaining an evaluation of temperatures which may be obtained by collision of dense beams of particles with one another or with a solid target. Brief considerations are also given to the possibility of the influence of a magnetic field. (TCO)

651
HIGH FREQUENCY HEATING OF PLASMA. (Work completed in 1956.) L. I. Rudakov and R. Z. Sagdeev. pp. 153–64 in "The Physics of Plasmas, Vol. III." (In Russian)

The method of heating the ions of the plasma based on using cyclotron resonance was investigated. Consideration of the characteristic fields of the plasma produced by the motion of ions and electrons can significantly change the character of the motion of the particles, violating the conditions of heating. In order to clear up the conditions under which acceleration of ions is possible, the problem of the motion of the particles in an external field was investigated without considering the influence of the characteristic self-consistent field of the plasma. The analysis of the influence of the self-consistent field of the plasma is carried out within the framework of the hydrodynamic approximation. (TCO)

652
THEORY OF RAPID PROCESSES. (Work completed in 1957). S. M. Osovets. pp. 165–81 in "The Physics of Plasmas, Vol. III." (In Russian)

Calculations are made which characterize the process of a rapid compression of a plasma column with consideration of the contour of the changing induction field. Basic relationships are obtained for the temperature of the compressed column and the time of compression. Conditions are examined for the disengagement of the plasma column from the walls of the vessel and a calculation is made of the mean temperature of the gas up to the moment of disengagement. (TCO)

653
INVESTIGATION OF A POWERFUL RING GAS DISCHARGE IN THE PRESENCE OF AN EQUILIBRIUM ORBIT. (Work completed in 1956). Yu. F. Nasedkin and S. M. Osovets. pp. 182–95 in "The Physics of Plasmas, Vol. III." (In Russian)

A powerful ring gas discharge under the influence of a variable magnetic field of special construction, which ensures the presence of an equilibrium stability in the current orbit, was investigated. The distribution of the current in the vacuum chamber was studied. The maximum energy of the motion of the turbulence to the center of the chamber after its disengagement from the orbit was evaluated as about 1500 ev. An evaluation was also made of the residual magnetic flow and active resistance of the gas turbulence. Descriptions of the apparatus used in the investigation of a ring discharge are given. Oscillographs of the magnetic fields and current under various conditions are shown. (TCO)

654
PLASMA TURBULENCE IN THE PRESENCE OF ACTIVE RESISTANCE. (Work completed in 1957). S. M. Osovets and N. I. Shchedrin. pp. 196–213 in "The Physics of Plasmas, Vol. III." (In Russian)

A theoretical investigation is given of the equilibrium conditions in the process of compression of a plasma turbulence for finite conductivity. It is shown that for the compression of the turbulence it is necessary to compensate the residual magnetic current by some field constant in time. Experimental results are given of compensating fields which confirm the theoretical conclusions. Conditions are obtained in which the residual current is completely compensated and the turbulence is compressed into a ball. Experiments have shown that with the rapid motion of the gas turbulence to the center, about $\frac{1}{4}$ of the internal magnetic current is frozen inside. This residual field hinders the compression of the orbits to smaller dimensions. In addition, part of

the magnetic energy is spent on the building up of the field. If one uses an additional central field, then for a given value of this field one observes a compensation of the residual current. In this case, one should expect that the magnetic energy will basically go over into kinetic energy of directed motion of the particles to the center with the consequent formation of a dense "ball." (TCO)

655

THE INFLUENCE OF THE FORM OF THE MAGNETIC FIELD ON THE RING GAS DISCHARGE. (Work completed in 1957). Yu. F. Nasedkin and E. I. Pavlov. pp. 214–30 in "The Physics of Plasmas, Vol. III." (In Russian)

A study is made of the behavior of a current gas pinch in a betatron field and the subsequent distribution of the current density along the cross-section of the chamber. It was found that the form of the field has an influence on the behavior of a current pinch. For small gas pressures in the chamber x-ray emission was detected. The experiments were carried out with deuterium and argon. (TCO)

656

INVESTIGATION OF THE PRESSURES IN A POWERFUL PULSE GAS DISCHARGE WITH THE HELP OF A PIEZO ELECTRIC MEASURING DEVICE. (Work completed in 1956). N. V. Pilippov. pp. 231–49 in "The Physics of Plasmas, Vol. III." (In Russian)

A description is given of the construction of a piezoelectric measuring device for measuring pressures in a pulse discharge and of the method of working with this device in a cylindrical discharge chamber with currents from 300 to 500 ka. Results of investigations of the pressure near the center of the chamber are given for a discharge in deuterium of a battery of condensers with 62 microfarads capacity. A new method is described for calibrating this device directly in the investigated gas discharge with the help of a diaphragm inertial device. (TCO)

657

THE BEHAVIOR OF RAPID ELECTRONS IN AN ELECTRON MODEL OF A TRAP WITH MAGNETIC MIRRORS. (Work completed in 1957). G. M. Antropov, V. A. Belyaev, and M. K. Romanovskii. pp. 250–8 in "The Physics of Plasmas, Vol. III." (In Russian)

One of the methods of creating a hot plasma is the accumulation of rapid ions in a volume with a magnetic field of a special form in which the particles are kept for a long time from hitting the walls. The simplest form of this magnetic trap is the field of a straight solenoid which is increased at the ends. This form was investigated using an electron model. It was concluded that the injected electrons moving in a magnetic field of the trap with magnetic mirrors make up to a thousand vibrations between the mirrors. The lifetime of rapid electrons in the system is determined, not by the conservation of the adiabatic invariant, but by the interaction of the electrons with the residual gas and by their destruction on the source. (TCO)

658

THE REPULSION OF CHARGED PARTICLES FROM REGIONS OF STRONG MAGNETIC FIELDS. (Work completed in 1956). O. B. Firsov. pp. 259–67 in "The Physics of Plasmas, Vol. III." (In Russian)

An attempt is made to determine the validity of the adiabatic invariant for the conditions found in magnetic traps with an axially symmetric field. (TCO)

659

A QUASI-HYDRODYNAMIC DESCRIPTION OF A DILUTE PLASMA IN A MAGNETIC FIELD. (Work completed in 1957). L. I. Rudakov and R. Z. Sagdeev. pp. 268–77 in "The Physics of Plasmas, Vol. III." (In Russian)

The kinetic equations, which describe the motion of the ions of a plasma in a magnetic field in the absence of collisions and are averaged with respect to the Larmor rotation, are generalized for the non-static case. The system of equations for the lower moments of the distribution function of the electrons and ions is analogous to the equations of two-liquid hydrodynamics. While formally the mean free path is infinite, its role is played by the Larmor radius of the ion (electron). With the help of the equations obtained, the wave equations corresponding to magnetic-hydrodynamic and acoustical vibrations were investigated. For a sufficiently large anisotropy of the tensor of pressure one obtains instabilities which lead to the destruction of the homogeneity of the plasma. The study of the motion of the completely ionized plasma in strong electromagnetic fields considering their own fields with the help of kinetic equations is rather difficult. The equations of hydrodynamics of two liquids (ions and electrons) starting from kinetic equations describing the averaging of the motion of the ions with respect to the Larmor rotation are deduced. (TCO)

660

SOME PROPERTIES OF THE PLASMA WITH ANISOTROPIC DISTRIBUTION OF THE VELOCITIES OF IONS IN THE MAGNETIC FIELD. (Work completed in 1957). A. A. Vedenov and R. Z. Sagdeev. pp. 278–84 in "The Physics of Plasmas, Vol. III." (In Russian)

The ionic (magneto-hydrodynamic) branch of the vibrational plasma was investigated with the help of the kinetic equation, and criteria were found for instability with neglect of collisions. Consideration of the proper magnetic field of the waves for a sufficiently anisotropic distribution function leads to a "transfer" of energy of longitudinal motion into the energy of the transverse motion (or vice-versa) by means of collective motion excitation which is associated with the ionic branch of plasma vibrations. (TCO)

661

MAGNETIC TRAPS WITH "GOFRIROVANOE" FIELD. (Work completed in 1956). B. B. Kadomtsev. pp. 285–99 in "The Physics of Plasmas, Vol. III." (In Russian)

The two simplest traps with "gofrirovanoe" magnetic fields, the principle of which is based on the increased drift of particles by the axis of the system by the placing of periodic fields, are described. The first of the traps works analogously to a simple trap with magnetic mirrors, i.e., the exit of particles from it is determined by the Coulomb collisions. In the second case, the basic exit of the particles arises from a toroidal drift. (TCO)

662

STABILIZATION OF PLASMA WITH THE HELP OF SHIELDING CONDUCTORS. (Work completed in 1957). S. I. Braginskii and B. B. Kadomtsev. pp. 300–26 in "The Physics of Plasmas, Vol. III." (In Russian)

A method is proposed for stabilizing the boundaries of plasma, the pressure of which is equilibrated by the magnetic field. The stability of the boundary is obtained with the help of "shielding" conductors. They form a lattice which is placed on the boundary of the plasma and takes on itself part of the pressure of the magnetic field. This excess pressure does not permit the plasma to go beyond the limits of the lattice. Stability of such a system is shown with respect to small vibrations. An

investigation was made of the form of the boundary of the plasma near the rods of the lattice. (TCO)

663
PLASMA IN "MAGNETIC NET." (Work completed in 1957). O. B. Firsov. pp. 327-35 in "The Physics of Plasmas, Vol. III." (In Russian)

An investigation was made of the escape of an electron-ion plasma from a volume surrounded by a constant magnetic field along the lines of force of the magnetic field. The configuration of the magnetic field is such that inside the plasma the field is absent. The possibilities of applying such a system for construction of a thermonuclear reactor are considered. (TCO)

664
STATIONARY DISTRIBUTION OF THE DENSITY OF THE PLASMA IN AN ELECTRO-MAGNETIC FIELD. (Work completed in 1957). T. F. Volkov. pp. 336-45 in "The Physics of Plasmas, Vol. III." (In Russian)

In the framework of hydrodynamics, the problem was solved for the stationary self-consistent distribution of density of plasma in a standing electro-magnetic wave. It is shown that in the hydrodynamic statement of the problem exact solutions are absent for which the density of the plasma in any region of space is equal to zero. An investigation was made of the influence of the magnetic field and of the walls limiting the plasma. (TCO)

665
CONTAINMENT OF THE PLASMA BY THE PRESSURE OF A STANDING ELECTRO-MAGNETIC WAVE. (Work completed in 1957). R. Z. Sagdeev. pp. 346-61 in "The Physics of Plasmas, Vol. III." (In Russian)

A description is given of a plasma which has such high temperature of ions and electrons that collisions can be neglected. As a basis of the consideration of the equilibrium state, the method of kinetic equations is used without the collision term, but with consideration of the self-consistent electro-magnetic field. The question of the stability of the boundary between the heated plasma and the standing electro-magnetic wave was investigated within the framework of the hydrodynamic equations. (J.S.R.)

666
CONTAINMENT OF A PLASMA BY TRAVELING MAGNETIC FIELD. (Work completed in 1957). S. M. Osovets. pp. 3-15 in "The Physics of Plasmas, Vol. IV." (In Russian)

An investigation is made of the question of containing a hot plasma by means of a field of a traveling wave. Expressions are obtained for magnetic fields and magnetic pressures produced on the surface of the plasma by a system of currents displaced in phase with respect to one another by some angle. Conditions are found under which the excitation of the surface of the plasma can be considered small. From these conditions, relations are found which determine the basic parameters of the contour which produce the traveling field. Relations are presented characterizing the energetic balance of the thermonuclear reactor in which the plasma is contained by the traveling field. (TCO)

667
HYDRODYNAMICS OF A PLASMA OF LOW PRESSURE. (Work completed in 1957). B. B. Kadomtsev. pp. 16-23 in "The Physics of Plasmas, Vol. IV." (In Russian)

Approx mate equations were obtained of the motion of a plasma, the pressures of which are many times lower than the pressure of the magnetic field. The question of equilibrium and stability of such a plasma is discussed. (TCO)

668
MAGNETO HYDRODYNAMIC WAVES IN A DILUTE PLASMA. (Work completed in 1958). S. I. Braginskii and A. P. Kazantsev. pp. 24-31 in "The Physics of Plasmas, Vol. IV." (In Russian)

An investigation is made of the magneto-hydrodynamic wave with an arbitrary direction of propagation, starting from kinetic equations with a self-consistent field without consideration of collisions. Just as in a conducting liquid, in a dilute plasma one can consider, in the general case, three types of magneto hydrodynamic waves. It is shown that in the absence of collisions these waves undergo a characteristic decay. (TCO)

669
THE MOTION OF CHARGED PARTICLES IN A MAGNETIC TRAP. (Work completed in 1957). L. S. Solov'ev. pp. 32-41 in "The Physics of Plasmas, Vol. IV." (In Russian)

In the approximation of the drift theory a calculation is made of the motion of a particle in the field of a trap with magnetic mirrors. The length of the trajectory of the particle, the tolerance for the curvature of the axis of the trap, and the influence of supplementary gaps of the field on the axis are determined. For a given parabolic approximation of the field on the axis it is possible to integrate in a closed form the equations of motion of the particle. (TCO)

670
THE MOTION OF A CHARGED PARTICLE IN THE RAPIDLY ALTERNATING ELECTRO-MAGNETIC FIELDS. (Work completed in 1958). A. A. Vedenov and L. I. Rudakov. pp. 43-8 in "The Physics of Plasmas, Vol. IV." (In Russian)

In a series of investigations the motion of particles was investigated in magnetic and electric fields slowly varying in time and space. The solution was obtained in the form of a series with increasing orders of small parameters Ω/ω and rH/L where Ω is the frequency of change of the electromagnetic field, ω is the Larmor frequency, r is the Larmor radius, and L is the characteristic size of the change of the field in space. In the present investigation it is shown in a concrete case how one can remove the limitation $\Omega/\omega \ll 1$, using for the solution only the small magnitude of r/L and δ/L, where δ is the displacement of the particle in time $1/\Omega$. (TCO)

671
STABILIZATION OF A PLASMA WITH THE HELP OF A SYSTEM OF RODS. (Work completed in 1958). D. V. Orlinskii. pp. 49-53 in "The Physics of Plasmas, Vol. IV." (In Russian)

Results of experiments to study the influence of transverse rods on the development of a pulse discharge in a cylindrical chamber are presented. These experiments have the purpose of obtaining preliminary experimental data on the work of such a system. (TCO)

672
INVESTIGATION OF THE STABILITY OF A CYLINDRICAL PLASMA COLUMN BY METHODS OF KINETIC EQUATIONS. (Work completed in 1958). L. I. Rudakov and R. Z. Sagdeev. pp. 54-60 in "The Physics of Plasmas, Vol. IV." (In Russian)

An investigation was made of the stability of a cylindrical plasma current column placed in a longitudinal magnetic field. The method of investigation was to use the kinetic expression in a "drift" approximation derived in the previous article, (Vol. III, page 268), with neglect of collisions. In the case of isotropy of the non-excited pressure, the criterion coincides with that ob-

tained in the magneto hydrodynamic approximation. In the case of the inequality of the longitudinal and transverse components of pressure, there is a possibility of a new instability even in the absence of a current on the axis of the column. (TCO)

673

STABILITY OF A PLASMA COLUMN WITH A DISTRIBUTED CURRENT. (Work completed in 1958). V. D. Shafranov. pp. 61-9 in "The Physics of Plasmas, Vol. IV." (In Russian)

The first investigations of the stability of the plasma column in the presence of a longitudinal magnetic field (Vol. I, page 207; Vol. II, page 144) were based on the assumption that the whole current was concentrated in an infinitely small surface layer. It was shown in this case that if the internal longitudinal field was greater than the outer field, then the column could be stable in the presence of a good conducting shell independently of the ratio of the length of the column to its radius. In the reverse case the column could be of a limited length L. For the case when the internal field is equal to the external field, the condition of stability was given. It is of some interest to clear up how these conditions are changed in the presence of volume currents. In the work of Volkov, Vol. II, p. 144, it was shown that the criterion of stability for an axially symmetrical excitation in the case of a homogeneous axial current does not differ markedly from the stability criteria obtained for the case of surface currents. Usually it is considered more difficult to obtain criteria of stability with respect to the bending of the column and more complicated types of excitation. In the case of the homogeneous current, it was found possible to carry out rather simply an investigation of all these forms of excitation. (TCO)

674

CALCULATION OF QUASI-STATIONARY ELECTROMAGNETIC FIELD IN A SYSTEM WITH TOROIDAL SYMMETRY. (Work completed in 1958). N. M. Polievktov-Nikoladze. pp. 70-80 in "The Physics of Plasmas, Vol. IV." (In Russian)

The analytical calculations of nonstationary electromagnetic fields in toroidal systems is extraordinarily difficult in view of the fact that Maxwell's equations in that case do not permit the separation of variables. It is shown that for toroidally-symmetrical thin conductors, the above difficulty disappears and the problem resolves itself to the solution of a system of integral equations for functions with one independent variable which can be carried out rather simply by the usual numerical methods. (TCO)

675

INVESTIGATION OF THE NEUTRON EMISSION ARISING IN A GASEOUS DISCHARGE WITH A CURRENT OF 160 KA. (Work completed in 1957). V. F. Demichev and Yu. G. Prokhorov. pp. 81-6 in "The Physics of Plasmas, Vol. IV." (In Russian)

An investigation is made of the neutron emission taking place in the gas discharge in a cylindrical tube with a current strength of 160 ka. It is shown that the neutron emission is due to the presence of deuterons in the discharge which are accelerated to large energies. From tables it is seen that the neutron radiation is non-isotropic. Experimental data obtained are against the assumption of the localization of the source of the neutrons in a small region of a discharge and against the uniform distribution of the intensity of the source along the axis. These data are consistent only with the assumption that the intensity of the source of neutrons increases along the axis from the anode to the cathode. A qualitative evaluation shows that it must change according to x^{Ω}, where x is the distance along the axis from the anode and Ω lies within the limits 1 to 2. (TCO)

676

A POSSIBLE MECHANISM OF THE NEUTRON EFFECT AT MASSIVE PULSE DISCHARGES IN DEUTERIUM. (Work completed in 1958). B. A. Trubnikov. pp. 87-97 in "The Physics of Plasmas, Vol. IV." (In Russian)

A possible mechanism of the neutron effect in discharges in deuterium is discussed. The mechanism is based on the assumption that in the process of the development of unstable excitation of the plasma column the plasma may be completely pushed out by the pressure of the magnetic field from several regions of the column. In such perturbations strong electrical fields may arise which may be the reason for the acceleration of deuterium ions causing a number of nuclear reactions. (TCO)

677

THE INFLUENCE OF A HIGH FREQUENCY ELECTROMAGNETIC FIELD ON THE VIBRATIONS OF A PLASMA. (Work completed in 1958). T. F. Volkov. pp. 98-108 in "The Physics of Plasmas, Vol. IV." (In Russian)

The hydrodynamic theory of the vibrations of a plasma in the field of a traveling electromagnetic wave is examined. It is shown that the frequencies of the acoustical and Langmuir vibrations in this case become functions of the amplitude of the high frequency field. The possible mechanisms for the formation of instabilities are discussed. (TCO)

678

THE VIBRATIONS AND STABILITY OF THE SURFACE PLASMA IN THE FIELD OF A TRAVELING ELECTROMAGNETIC WAVE. (Work completed in 1958). T. F. Volkov. pp. 109-15 in "The Physics of Plasmas, Vol. IV." (In Russian)

The surface vibrations of a plasma in the field of a traveling high-frequency electromagnetic wave are considered. It is shown that the plane surface of the plasma is in this case unstable, independently from the magnitude of the external electromagnetic wave. The greatest increment is produced by excitations, the wave length of which is close to half the wave length of the electromagnetic vibration. (TCO)

679

THE ELECTRODELESS DISCHARGE WITH HIGH CURRENT IN A TOROIDAL CHAMBER WITH A LONGITUDINAL MAGNETIC FIELD. (Work completed in 1957). A. L. Bezbatchenko, I. N. Golovin, P. I. Kozlov, V. S. Strelkov, and N. A. Yavlinskii. pp. 116-33 in "The Physics of Plasmas, Vol. IV." (In Russian)

The ignition and propagation of an electrodeless discharge in a magnetic field was investigated. The heating of plasma to temperatures which, although not sufficient for the detection of neutrons from the thermonuclear reaction, correspond to a high ionization of the plasma and to the frozen-in-state of the magnetic field was also studied. The design of the apparatus used is given. The investigations were made in a toroidal chamber without a longitudinal magnetic field and with a longitudinal magnetic field of up to 15,000 oersteds, with an electric field from 0.15 to 6.5 v/cm for the duration of the first half period of current flow from 350 to 2,000 μsec, and with the initial pressure of the deuterium from 7×10^{-4} to 0.2 mm. (J.S.R.)

680

THE MEASUREMENT OF THE ELECTRON TEMPERATURE AND ION CONCENTRATION BY A DOUBLE

FLOATING PROBE IN AN ELECTRODELESS DISCHARGE. (Work completed in 1957). V. I. Pistunovich. pp. 134-55 in "The Physics of Plasmas, Vol. IV." (In Russian)

A determination was made of the value of the electron temperature, ion density, and the coefficient of ionization of a discharge in a toroidal chamber for the conditions U = 12 and 25 kv, p = 0.04 mm, and external field equal to 0. It is shown that the average electric fluctuations in the plasma does not affect the results of the temperature measurements of the electrons. The measurement of the electron temperature and the ion density at different distances from the center of the chamber show that the parameters of the plasma change only slightly in a given cross section of the chamber. The parameters of the plasma do not change in their dependence on the orientation of the double probe with respect to the chamber axis. The possibility is suggested of using the double floating probe for the measurement of electron temperatures and ion density of plasma for fields up to 1,000 oersteds. (TCO)

681

INVESTIGATION OF THE RADIATION OF AN ELECTRODELESS DISCHARGE IN DEUTERIUM. (Work completed in 1958). V. S. Strelkov. pp. 156-69 in "The Physics of Plasmas, Vol. IV." (In Russian)

Experiments are described on the investigation of the radiation of an electrodeless pulse discharge in the visible and x-ray part of the spectrum. The x rays are formed because of the deceleration of rapid electrons in the target material or on the walls of the discharge chamber. The region of origin and the average energy of the rapid electrons are determined. The time dependence of the intensity of the spectral lines of deuterium and silicon is determined in the visible part of the spectrum. The change in time of the spectral intensity of deuterium lines shows that at a certain amount of time there is a high degree of plasma ionization. The subsequent increase in the intensity of the spectral lines of deuterium is associated probably with the appearance of impurities from the wall of the chamber. The moment of the appearance of the impurities is not associated with the magnitude of the external magnetic field and is probably determined by the time of diffusion of the impurities from the chamber walls to the volume. (TCO)

682

POWERFUL GAS DISCHARGE IN CHAMBERS WITH CONDUCTING WALLS. (Work completed in 1957). D. P. Petrov, N. V. Filippov, T. I. Filippova, and V. A. Khrabrov. pp. 170-81 in "The Physics of Plasmas, Vol. IV." (In Russian)

Results are described of the investigation of a pulse gas discharge in a straight two-electrode chamber with conducting walls. A difference of the process of formation of the discharge compared to that with ceramic walls is established. The pulsed neutron emission was detected and investigated in a large range of gas pressures: 0.02 to 60 mm, 85 to 145 mkf, 100 to 600 ka, and rise time of current 4×10^{10} to 2×10^{11} a/second. It is shown that the source of the neutron emission is localized in the pre-anode region of the discharge. (TCO)

683

INVESTIGATION OF THE PULSE DISCHARGE IN DEUTERIUM FOR VELOCITIES OF CURRENT RISE OF UP TO 10^{12} amp/sec AND POTENTIALS TO 120 kv. (Work completed in 1958). A. M. Andrianov, O. A. Bazilevskaya, and Yu. G. Prokhorov. pp. 182-200 in "The Physics of Plasmas, Vol. IV." (In Russian)

It is shown that for an initial potential greater than 80 kv, the duration of the neutron pulse increases significantly up to 2 to 3 microseconds, but that the duration of the pulse of the hard x ray remains the same as for lower potentials (0.2 to 0.3 μsec). (TCO)

684

THE THEORY OF THE COMPRESSION AND PULSATION OF A PLASMA COLUMN IN A STRONG PULSE DISCHARGE. (Work completed in 1958). S. I. Braginskii, I. M. Gel'fand, and R. P. Fedorenko. pp. 201-21 in "The Physics of Plasmas, Vol. IV." (In Russian)

An investigation was made of the magneto-hydrodynamic problem of the compression and the pulsation of a plasma column. A system of equations with partial derivatives which describe the column, together with the electrical engineering equations for the discharge circuit, were numerically integrated on an electronic calculating machine. The results of the calculation were compared with experimental data. (TCO)

685

INVESTIGATION OF THE PROCESS OF ELECTRODYNAMIC ACCELERATION OF CLUMPS OF PLASMA (II). (Work completed in 1957). I. M. Podgornyi, S. A. Chuvatin, G. A. Bykov, and V. D. Pis'mennyi. pp. 222-34 in "The Physics of Plasmas, Vol. IV." (In Russian)

An analysis of experiments for determining the velocity and the size of the plasma oscillations with the help of photoelectric methods is given. In addition to this, there is a comparison of the theoretically calculated curve of the current with that experimentally observed. An analysis of the current oscillograph gives for the mean velocity of the motion of the plasma oscillations a value of (1.1 to 1.2) × 107 cm/sec. (TCO)

686

THE RADIAL DISTRIBUTION OF POTENTIAL IN A CYLINDRICAL MAGNETIC TRAP USING A MAGNETRON METHOD OF ION INJECTION. (Work completed in 1957). E. E. Yushmanov. pp. 235-57 in "The Physics of Plasmas, Vol. IV." (In Russian)

The results of investigations of the distribution of the potential along the radius in a cylindrical magnetic trap with magnetic mirrors and using a magnetron method of creating a plasma containing rapid ions are presented. The potential distribution was measured in its dependence on the magnitude of the applied potential, magnetic field, and other parameters. The measured potential distribution differed radically from the theoretical distribution corresponding to a non-compensated volume charge in the magnetron. Regular vibrations of the potential of the plasma were found under certain conditions with a frequency of 200 to 400 cycles per second. The amplitude of these vibrations was measured. (TCO)

687

THE WIDENING OF SPECTRAL LINES IN A HIGH TEMPERATURE PLASMA. (Work completed in 1957). V. I. Kogan. pp. 258-304 in "The Physics of Plasmas, Vol. IV." (In Russian)

A theory is developed for the widening of spectral lines in an idealized plasma taking care (in the framework of a classical adiabatic model) of the simultaneous excitation of the emitting atoms by a large number of charged particles present in the heat discharge. General formulas were obtained for the distribution of intensity of the Stark component of the lines widened because of the linear and quadratic Stark effect. These formulas were simplified for the limiting cases of large and small densities and plasma temperature. The present shock theory was shown to be inapplicable to the widen-

ing produced by the linear Stark effect. The simultaneous widening action of ions and electrons was investigated. The form of the line for the simultaneous consideration of the Holtzmark and Doppler mechanism of widening was found. The results (and likewise the role of several other mechanisms for widening lines) were discussed as applicable to plasma of a massive pulse discharge in hydrogen. (TCO)

688

THE RELATION BETWEEN THE COEFFICIENTS OF ABSORPTION AND EMISSION OF PLASMA RADIATION PRESENT IN A MAGNETIC FIELD. (Work completed in 1957). B. A. Trubnikov. pp. 305-8 in "The Physics of Plasmas, Vol. IV." (In Russian)

A brief theoretical discussion is presented on the relationship between the coefficients of absorption and emission of plasma radiation present in a magnetic field. (J.S.R.)

689

THE BEHAVIOR OF PLASMA IN A RAPIDLY VARYING MAGNETIC FIELD. (Work completed in 1957). B. A. Trubnikov. pp. 309-30 in "The Physics of Plasmas, Vol. IV." (In Russian)

An examination is made of the methods of thermal isolation and heating of a plasma with the help of external rapidly varying magnetic fields. It is shown that by a suitable choice of the geometry of the field the clump of the plasma can be in equilibrium and therefore stable. The questions of heating the plasma are partially examined. (TCO)

690

CHERENKOV GENERATION OF MAGNETO-ACOUSTICAL WAVES. (Work completed in 1958). A. I. Morozov. pp. 331-52 in "The Physics of Plasmas, Vol. IV." (In Russian)

An investigation was made of the generation of magneto-acoustical waves in both limited and unlimited plasma. The source of the wave is considered to be contours with currents moving at high velocities. A system of magneto-hydrodynamic equations for an ideal liquid is used to describe the waves since the equations are applicable when the frequency of collisions of ions with neutral particles is much larger or smaller than the wave frequency. (J.S.R.)

691

MAGNETIC TRAPS FOR PLASMA. (Work completed in 1957). B. B. Kadomtsev. pp. 353-63 in "The Physics of Plasmas, Vol. IV." (In Russian)

A hydrodynamic investigation is made of magnetic traps. It is shown that systems with 'shielding conductors' are also magnetic traps, the losses from which are due basically to the suspensions. The presence of stability was established in "traps with Gofrir field." (TCO)

692

THE INSTABILITY OF PLASMA IN A MAGNETIC FIELD IN THE PRESENCE OF IONIC BEAMS. (Work completed in 1958). B. B. Kadomtsev. pp. 364-9 in "The Physics of Plasmas, Vol. IV." (In Russian)

In some cases in the plasma there may be directed beams of ions. Thus, in the plasma of an ionic magnetron created with the help of accelerating ions in a radial electric field, all ions undergo approximately the same periodic motion: moving in a radial direction they change the velocity direction under the action of a magnetic field and then at a certain point they turn around and return to the central region of the plasma. Such a motion leads to the formation of two beams of ions meeting each other in radial directions. An analogous situation may arise in the adiabatic trap with magnetic mirrors for the production of plasma by means of accumulation of ions from an ion source. Such a plasma occupies a ring region with a thickness equal to the diameter of the ion ring. But the ions again form two counter-currents in radial direction. As is well known, the electron beams in a plasma may be unstable. An analogous situation can take place in the given case. The instability of plasma with respect to short waved excitations, the wave length of which is much smaller than the mean Larmor radius of the ions, is investigated. It is seen that the beam of ions in the plasma will be unstable if the scatter of ions in velocity is very small. (TCO)

693

THE DYNAMICS OF PLASMA IN A STRONG MAGNETIC FIELD. (Work completed in 1958). B. B. Kadomtsev. pp. 370-9 in "The Physics of Plasmas, Vol. IV." (In Russian)

It is shown that for the motion of the plasma, which is slow compared with the cyclotron frequencies of the ions, the motions can be described by the totality of equations of hydrodynamics for the motion across the magnetic field and kinetic equations for the transverse motion. These equations can be simplified partially for the case of a plasma whose pressure is much smaller than the magnetic pressure. An examination is made of the question of stability of the plasma of low pressure in a Gofrir field. (TCO)

694

THE CONVECTIVE INSTABILITY OF A PLASMA. (Work completed in 1958). B. B. Kadomtsev. pp. 380-3 in "The Physics of Plasmas, Vol. IV." (In Russian)

The instability of equilibrium magneto-hydrodynamic configurations with closed lines of force is investigated with respect to a definite form of perturbation. (TCO)

695

NON-LINEAR MOTIONS OF A DILUTED PLASMA IN A MAGNETIC FIELD. (Work completed in 1958). R. Z. Sagdeev. pp. 384-90 in "The Physics of Plasmas, Vol. IV." (In Russian)

A solution was found for established magneto-acoustical waves of large amplitude propagated across the magnetic field. (TCO)

696

THE QUENCHING OF VIBRATIONS OF A PLASMA COLUMN. (Work completed in 1958). A. I. Morozov and L. S. Solov'ev. pp. 391-414 in "The Physics of Plasmas, Vol. IV." (In Russian)

Questions of quenching of vibrations of a plasma cylinder with the help of different shields placed on the surface of the plasma were examined. The different cases of the vibrations of the plasma investigated in this work show that these vibrations can be quenched effectively with the help of a casing that has been picked in an appropriate manner. If the casing is a non-conducting material, the quenching takes place via the Cherenkov effect. For intensive quenching under the conditions of stability, it is necessary that the ratio of the distance of the plasma to the shielding to the dielectric permeability be several times, 2 to 10, smaller than the period of the wave. If the casing is conducting, for effective quenching it is necessary that the skin layer corresponding to the frequency of the vibration of the wave be several times smaller than the above ratio. It is noted that it is not necessary to quench the vibration with the help of a conducting layer; that is, with the help of the Joule heating of this layer. One can also heat

the waves with Cherenkov effect, at which the energy of vibration of the plasma is removed in the form of high frequency electromagnetic waves. The remarks made above would appear to deal only with the stabilization of high frequency vibrations of the plasma. The slow 'creeping away' of the plasma column can be stabilized by internal fields of the type proposed by Osovets (Vol. II, page 238) or by thick copper screening. The layer quenching the vibrations can be put on the internal surface of such a shield. The quenching layer may effectively iron out the turbulent electrical fields inside the toroidal chamber with copper cut casing and in this way serve as a liner if its vacuum properties turn out to be sufficiently good. (TCO)

697

DEDUCTION OF THE TENSOR OF DIELECTRIC PERMEABILITY OF A PLASMA. (Work completed in 1958). V. D. Shafranov. pp. 416-21 in "The Physics of Plasmas, Vol. IV." (In Russian)

By means of the integration of the kinetic equation along the trajectories of charge, a general expression was obtained for the tensor of dielectric permeability of a plasma in the absence of collisions. (TCO)

698

ABSORPTION OF ELECTRO-MAGNETIC WAVES PROPAGATING ALONG A CONSTANT MAGNETIC FIELD IN A PLASMA. (Work completed in 1958). R. Z. Sagdeev. pp. 422-5 in "The Physics of Plasmas, Vol. IV." (In Russian)

An investigation is made of the question of the absorption of electromagnetic waves in a plasma because of the thermal motion of electrons. It is of interest to analyze the mechanisms of the absorption of the energy of the plasma under conditions when one can neglect the collision of particles in pairs. This is particularly essential for high temperatures when the Joule absorption is sharply decreased and it is necessary to look for more effectively acting mechanisms and, in the first order, those not associated with colliding particles. Solutions are given of the problem of the propagation of the electromagnetic wave along a constant magnetic field without using the procedures of linearization, but neglecting the inner action of the magnetic field of the wave on electrons for sufficiently general initial conditions. This analysis can be considered as a particular case of the results of a linearized theory. (TCO)

699

THE INDEX OF REFRACTION OF A PLASMA IN A MAGNETIC FIELD IN THE REGION OF THE ION CYCLOTRON RESONANCE. (Work completed in 1958). V. D. Shafranov. pp. 426-9 in "The Physics of Plasmas, Vol. IV." (In Russian)

In connection with the problem of dissipation of energy in a plasma in the absence of collisions, it is of interest to determine the conditions under which there is an absorption of energy of the electromagnetic field by the particles of the plasma, (the range of frequencies, direction of the propagation of the field, etc.). For determining the region of absorption of the electromagnetic field by the ions the square of the index of refraction of the plasma is calculated with consideration of the motion of the ions along the lines of force of the magnetic field. (TCO)

700

THE VIBRATIONS OF A PLASMA COLUMN WITH CONSIDERATION OF THE HEAT MOTION OF THE IONS. (Work completed in 1958). R. Z. Sagdeev and V. D. Shafranov. pp. 430-5 in "The Physics of Plasmas, Vol. IV." (In Russian)

As is well known, on increasing the temperature of a plasma the effectiveness of the usual Joule mechanism for heating drops. It is of interest to investigate other methods of heating of the plasma. One of these methods is the 'betatron' method of heating, based on the periodic change of the magnetic field with a period comparable with the time of ion collisions. A solution is given of the problem of the vibrations of a cylinder of plasma with consideration of the heat motion of the ions leading both to Cherenkov and cyclotron absorption. (TCO)

CRITICALITY STUDIES

701 AECU-3860

Knolls Atomic Power Lab., Schenectady, N. Y.

TWO-DIMENSIONAL (r,z) MULTIGROUP CALCULATION FOR AN INTERMEDIATE SPECTRUM CRITICAL ASSEMBLY. P. L. Hofmann and M. L. Storm. [Apr. 14, 1957]. 49p. Contract [W-31-109-Eng-52]. (M-6262). $7.80(ph OTS); $3.30(mf OTS).

The results of two-dimensional (r,z) multigroup calculations of an experimental low-power reactor (PPA-19) are described. Comparison is made between calculated results and experimental measurements of reactivity, power distribution, and sodium activation. Generally good agreement is observed between calculation and experiment. This calculation was performed in 1954 and represents the first application of Roe's two-dimensional multigroup formulation to the analysis of an operating critical assembly. The over-all objective of such calculations is to ascertain the accuracy of two-dimensional multigroup methods in order to facilitate their application to future problems in reactor design. (auth)

702 APAE-36

Alco Products, Inc., Schenectady, N. Y.

THE ALCO PRODUCTS, INC. CRITICALITY FACILITY. DESCRIPTION AND OPERATION. John W. Noaks. July 16, 1958. 62p. $9.30(ph OTS); $3.60(mf OTS).

The Alco Products Criticality Facility, site location, and operating procedures are described in detail, including the handling of fissionable material and the operating procedures for the safe performance of critical experiments. (auth)

GEOLOGY AND MINERALOGY

703 NYO-7948

Pennsylvania State Univ., University Park. Coll. of Mineral Industries.

AN INVESTIGATION OF THE MINERALOGY, PETROGRAPHY, AND PALEOBOTANY OF URANIUM-BEARING LIGNITES. Consists of thesis: URANIUM MINERALIZATION IN SOME NORTH AND SOUTH DAKOTA LIGNITES. Eugene Wilbert White. Apr. 2, 1958. 86p. Contract AT(30-1)-2000. $2.25(OTS).

The megascopically visible uranium minerals from eleven deposits of Tertiary lignite from North and South Dakota are characterized on the basis of optical, chemical, x-ray-diffraction and dehydration properties. The uranium mineral occurrences are divided into three areas on the basis of stratigraphy and geography. Eleven of the twelve minerals are hydrated uranium phosphates, one is an arsenate. Eleven, including the arsenate, belong to the group of torbernite-metatorbernite minerals. Sodium-autunite $Na_2(UO_2)_2(PO_4)_2 \cdot nH_2O$ is found in four of the deposits. This is the first reported oc-

currence of the mineral in this country. The other identified minerals include: meta-uranocircite, meta-autunite, hydrogen-autunite, saléeite, sabugalite (?), abernathyite and hydrogen-autunite (?). A new mineral which is apparently a sodium uranium phosphate has been studied but not completely characterized. Blockyness of the lignite favors uranium deposition. The minerals have no observed affinity to particular lignite macerals. The sodium-autunite is associated with lignites having a high solubility in water and dilute hydroxide solutions. The uranium minerals in the Cave Hills and Billings County areas appear to have formed after removal by erosion of the overlying beds of volcanic material which are thought to have been the source of the uranium. This indicates that in these areas the uranium must have been precipitated originally in the lignite and subsequently leached and redeposited in the near surface portions of the same or nearby seams. (auth)

704 TEI-530
Geological Survey, Washington, D. C.
URANIUM IN THE PHILLIPS MINE-CAMP SMITH AREA, PUTNAM AND WESTCHESTER COUNTIES, NEW YORK. Harry Klemic, John H. Eric, James R. McNitt, and Frank A. McKeown. Jan. 1957. 57p., 3 illus. $13.80(ph OTS); $4.80(mf OTS).

Uraniferous rock was discovered in the Phillips mine-Camp Smith area in 1953. Precambrian rocks of the Hudson Highlands of the New England physiographic province underlie the area. Hornblende pegmatite intrudes hornblende gneiss and diorite. The hornblende pegmatite and diorite are conformable with regional structures in the gneiss. Cross-cutting bodies of oligoclase-quartz pegmatite intrude the diorite and hornblende gneiss. Uraninite occurs in hornblende pegmatite and in adjacent hornblende gneiss and diorite in an elongate zone that is mineralized with magnetite and iron sulfides. The mineralized zone strikes northeast and dips steeply northwest. The Phillips pyrrhotite-pyrite ore body at the northeast end of this zone plunges northeast. The uraninite is in crystals and grains, most of which range from a millimeter to a centimeter in diameter. Subhedral uraninite crystallized from the pegmatite magma. The isotopic age of a crystal of uraninite from the hornblende pegmatite is about 920 million years. Magnetite is believed to have been emplaced during the latest stages of the consolidation of the hornblende pegmatite and is associated with secondary augite resulting from the alteration, possibly pneumatolytic, of hornblende in the pegmatite and adjacent rocks. The solutions that deposited magnetite and altered hornblende to augite embayed and rounded some of the uraninite crystals. Iron sulfides are believed to have been deposited by hydrothermal solutions that followed the main channels through which the hornblende pegmatite magma and the magnetite solutions had been introduced. Later, oligoclase-quartz pegmatite intruded the area discordantly. The lead-alpha age of zircon from the oligoclase-quartz pegmatite is about 620 million years. Results of exploration suggest that the deposits are submarginal under 1955 marketing conditions for uranium. (auth)

705 TEI-534
Geological Survey, Washington, D. C.
SELECTED ANNOTATED BIBLIOGRAPHY OF THE URANIUM GEOLOGY OF IGNEOUS AND METAMORPHIC ROCKS IN THE UNITED STATES AND TERRITORIES. Diane Curtis. July 1956. 181p., 1 illus. $28.80(ph OTS); $8.40(mf OTS).

This bibliography is an annotated list of selected reports that were publicly available as of May 31, 1956, pertaining to the uranium content and/or radioactivity of igneous and metamorphic rocks and minerals in the United States, Alaska, and Hawaii. The annotations are listed alphabetically by author, and chronologically if there is more than one report by the same author. The references are numbered consecutively for indexing purposes. The annotations express only the ideas of the authors, but occasionally information has been included for clarification. Such material is enclosed in brackets. A survey of the literature emphasized the paucity of published analytical data on this subject. Consequently, many reports that contain radioactivity data (particularly those with chemical analyses for uranium) are included in the bibliography, even though such reports may have little geologic information. (auth)

706 TEI-539
Geological Survey, Washington, D. C.
THE ASSOCIATION OF URANIUM WITH CARBONACEOUS MATERIALS ON THE COLORADO PLATEAU. Irving A. Breger and Maurice Deul. July 1955. 35p. $6.30(ph OTS); $3.00(mf OTS).

On the Colorado Plateau uranium is associated with coalified wood, crude oil, carbonaceous shale, and carbonaceous matter of unknown origin. Investigations have shown that crude oil plays no role in the emplacement of uranium, although its ability to pick up small quantities of uranium while migrating through uraniferous zones may make oils an aid to general prospecting. Carbonaceous matter with no cellular structure that occurs as impregnations in sandstones or as pellets has been chemically related to coal and is thought to represent a coal extract. The reduction to U(IV) of uranium associated with coalified wood may take place after absorption of the uranyl ion. Study of a terrestrial shale shows that the uranium is associated with carbonaceous material similar to lignite in chemical composition. From these studies it is concluded that the fundamental association of uranium with carbonaceous material on the Colorado Plateau is with coalified wood and allied chemical substances. (auth)

707 TEI-604
Geological Survey, Washington, D. C.
BOTANICAL PROSPECTING FOR URANIUM IN THE CIRCLE CLIFFS AREA, GARFIELD COUNTY, UTAH. F. J. Kleinhampl and Carl Koteff. Dec. 1956. 41p., 1 illus. $7.80(ph OTS); $3.30(mf OTS).

Plant-analysis prospecting may be used to locate uranium deposits in the Circle Cliffs area where the deposits lie as much as 70 ft beneath the surface of benches developed on the Shinarump member of the Chinle formation. The Shinarump comprising the benches is thicker than 70 ft at many places, however, and restricts the use of the plant-analysis prospecting method. Astragalus pattersoni and Stanleya pinnata broadly define some uraniferous localities adjacent to the contact of the Moenkopi formation and the Shinarump member of the Chinle formation, but the general paucity of Astragalus in the Circle Cliffs area limits the usefulness of this genus. Astragalus pattersoni, Stanleya pinnata, and Aster venustus(?) may serve as guides to mineralized parts of the Salt Wash sandstone member of the Morrison formation in the Circle Cliffs area. Thick and thin sandstones of the Shinarump member generally can be distinguished by pinyon-juniper ratio studies. These studies may supplement drilling to define channel-fill sandstones which are associated with ore deposits in the Circle Cliffs area. Ratio studies appear to be applicable to other areas throughout the Colorado Plateau where similar geological and ecological conditions exist. (auth)

708 TEI-618
Geological Survey, Washington, D. C.
LEAD-ALPHA AGE DETERMINATIONS OF GRANITIC ROCKS FROM ALASKA. J. J. Matzko, H. W. Jaffe, and C. L. Waring. Mar. 1957. 27p. $4.80(ph OTS); $2.70(mf OTS).

Lead alpha activity age determinations were made on zircon from seven granitic rocks of central and southeastern Alaska. The results of the age determinations indicate two periods of igneous intrusion, one about 95 million years ago, during the Cretaceous period, and another about 53 million years ago, during the early part of the Tertiary. The individual ages determined on zircon from 2 rocks from southeastern Alaska and 1 from east-central Alaska gave results of 90, 100, and 96 million years; those determined on 4 rocks from central Alaska gave results of 47, 56, 58, and 51 million years. (auth)

709 TEI-624
Geological Survey, Washington, D. C.
URANIUM CONTENT OF GROUND AND SURFACE WATERS IN WESTERN KANSAS, EASTERN COLORADO, AND THE OKLAHOMA PANHANDLE. E. R. Landis. July 1956. 73p., 1 illus. $13.80(ph OTS); $4.80(mf OTS).

During 1954, 1955, and 1956, 324 water samples were collected in western Kansas, eastern Colorado, the Oklahoma Panhandle, and northeastern New Mexico, to determine the uranium content of water from the various rock units and geologic terranes in the region, and to locate areas in which large amounts of uranium in the water might reflect the presence of nearby uranium accumulations. Water samples from some of the rock units in the area, particularly those of Triassic and Permian age, contain large amounts of uranium, and in some parts of the report area, such as the Cimarron River area of westernmost Oklahoma and northeastern New Mexico, and the Rule Creek area in Bent and Las Animas Counties, Colo., most, or all, of the water samples collected contain relatively large amounts of uranium. Further exploration to determine the source of the uranium in the water from these rock units and areas may be worthwhile. (auth)

710 TEI-669
Geological Survey, Washington, D. C.
LABORATORY STUDY OF URANIUM-BEARING CARBONACEOUS SHALE AND IMPURE COAL FROM GOOSE CREEK DISTRICT, CASSIA COUNTY, IDAHO. Ralph J. Gray. Apr. 1957. 22p. $4.80(ph OTS); $2.70 (mf OTS).

Petrographic studies of impure coal and carbonaceous shale deposits of the Salt Lake formation of early Pliocene age from two localities in the Goose Creek district in southern Idaho show little variation in organic composition and a range of 0.0 to 0.1% uranium. The beds are very fine textured and consist of minutely fragmented organic material mixed with larger amounts of mineral matter, much of which is of volcanic origin. In general, samples richest in uranium contain the greatest amounts of finely divided organic matter. The uranium-bearing carbonaceous rock is associated with altered volcanic materials, and the nonuraniferous carbonaceous rock is associated with unaltered volcanic material. The studies show that no quantitative correlation is apparent between uranium content and recognized types of organic matter, although the humic matter and the yellow waxy amorphous matter of the coaly layers apparently contain most of the uranium. (auth)

711 TEI-684
Geological Survey, Washington, D. C.
THE CRYSTAL STRUCTURES OF THREE NEW VANADIUM OXIDE MINERALS. Howard T. Evans, Jr., and Mary E. Mrose. June 1957. 11p. $3.30(ph OTS); $2.40(mf OTS).

Three new vanadium oxide minerals from sandstone deposits have been characterized by the techniques of x-ray diffraction and crystal structure analysis. Häggite, $V_2O_3 \cdot V_2O_4 \cdot 3H_2O$, from Carlile, Wyo., occurs as small black crystals intergrown on a fine scale with a second incompletely described vanadium oxide phase. Doloresite, $3V_2O_4 \cdot 4H_2O$, occurs commonly on the Colorado Plateau in dark brown crystalline masses as an alteration product of montroseite. Duttonite, $V_2O_4 \cdot 2H_2O$, is found as pale brown crystals coating cavity walls at the Peanut mine, Montrose County, Colo. All three have monoclinic crystal structures based on single and double VO_6 octahedron chains linked into various types of sheets. (auth)

712 TEM-785
Geological Survey, Washington, D. C. and Bureau of Mines.
A COMPARISON AMONG CALIPER LOG, GAMMA-RAY LOG AND OTHER DIAMOND-DRILL HOLE DATA. C. M. Bunker and H. C. Hamontre. May 1955. 21p. $4.80(ph OTS); $2.70(mf OTS).

To obtain comparative data on the variation in gamma-ray intensity accompanying possible variation in the diameter of small-diameter diamond-drill holes, six drill holes in the Jo Dandy area, Montrose County, Colo., were caliper logged using a well-bore caliper recently developed by the U. S. Bureau of Mines. The caliper logs show that within radioactive ore zones the variation in drill-hole diameter is insufficient to cause significant variation in the gamma-ray logging measurement, that with increasing particle size in the ore-bearing sandstone the drill-hole diameter tends to increase slightly, and that with increase in hole diameter the core recovery tends to decrease slightly. (auth)

713
CHEMICAL-PETROGRAPHIC STUDY OF THE PERMIAN SERIES OF THE BRIC COLME (MARITIME ALPS) AND OF THE ADJACENT URANIUM MINERALIZATIONS. Sergio Lorenzoni. pp. 435-98 in "Studi e ricerche della divisione geomineraria, Volume I, Parte II." Rome, Comitato Nazionale per le Ricerche Nucleari, 1958. 452p. (In Italian)

In the region investigated, south of Cuneo in the Maritime Alps, Permian and Triassic formations are found. The Permian formations are investigated with respect to the pre-metamorphic features of the rocks and their origin. The mineralization of uranium oxides and pyrites are described. (J.S.R.)

714
THE GRANITES OF MOUNT BLANC AND ITS URANIUM MINERALIZATION. Paolo Baggio. pp.527-652 in "Studi e ricerche della divisione geomineraria, Volume I, Parte II." Rome, Comitato Nazionale per le Ricerche Nucleari, 1958. 452p. (In Italian)

The Mount Blanc granite with its uraniferous mineralizations is described. The results, with respect to the intrusive mass, are discussed from a geological-tectonic, petrographic, and chemical viewpoint. The petrographic investigation and the chemical analysis of the samples established the prevailing features of the magnetism, which appears to be of the calc-alkaline type. The uraniferous mineralization appeared to have

sealed some Hercynian fractures and to have been remobilized by some subsequent dynamo-metamorphic Alpine activities. The prevailing secondary features of the mineralization are emphasized by the comparison of the present uraniferous compounds with the chemical and physical analyses, which showed a lack of equilibrium in the minerals observed. (J.S.R.)

715

CONTRIBUTION TO THE KNOWLEDGE OF SECONDARY URANIUM MINERALS IN THE ORE DEPOSITS OF VAL DAONE AND VAL RENDENA. Carlo L. Garavelli and Fiorenzo Mazzi. pp. 761-84 in "Studi e ricerche della divisione geomineraria, Volume I, Parte II." Rome, Comitato Nazionale per le Ricerche Nucleari, 1958. 452p. (In Italian)

Some uranium-bearing secondary minerals occurring in the upper zone of the uranium deposits of Val Daone and Val Rendena were studied. These mineralizations are enclosed in layers of upper Permic sandstones and show many geological analogies with those of Colorado and the Ferghana region. The identification of the different minerals was accomplished by x-ray methods. Optical and microchemical investigation, as well as examination of the fluorescence in ultraviolet light, was also used. The minerals found are described. (J.S.R.)

716

THE POSSIBILITY OF A PARTIAL SUBSTITUTION OF CALCIUM WITH URANIUM IN APATITE LATTICE. Guido Carobbi and Fiorenzo Mazzi. pp. 793-8 in "Studi e ricerche della divisione geomineraria, Volume I, Parte II." Rome, Comitato Nazionale per le Ricerche Nucleari, 1958. 452p. (In Italian)

The hypothesis that uranium isomorphically substituted calcium in the apatite lattice was examined. The results of examinations of sedimentary and magmatic genesis have given no proof of this hypothesis. (J.S.R.)

717

EXPLORATION FOR URANIUM-VANADIUM DEPOSITS BY THE U. S. GEOLOGICAL SURVEY IN THE CLUB MESA AREA URAVAN DISTRICT, MONTROSE COUNTY, COLORADO. MINERAL INVESTIGATIONS FIELD STUDIES MAP MF 169. R. L. Boardman, L. R. Litsey, and H. E. Bowers. Washington, U. S. Geological Survey, 1958. $0.75.

All the large uranium-vanadium deposits found by the drilling in the Club Mesa area are in or near the thickest parts, locally, of the host sandstone units, and generally are within a few hundred feet of appreciable thinning of these units. Where ore was penetrated, the host sandstone units range in thickness from 25 to 96 ft and average about 50 ft in thickness. About 75% of the holes in ore, accounting for nearly 90% of the estimated ore reserves, penetrated host sandstone units ranging in thickness from 30 to 60 ft. Results of the drilling in the Club Mesa area show the relative thickness of the ore-bearing sandstone units of the Salt Wash member and the amount of green or gray mudstone in contact with these units to be the most consistent recognizable geologic criteria associated with mineralized rock and ore deposits. Approximately 86% of the holes in mineralized sandstone units of the Salt Wash and 93% of the holes in ore penetrated host sandstone units 30 ft or more thick that are in contact with at least 6 in. of green or gray mudstone. These mudstone beds may be at the top, base, or included in the host sandstone unit. If these minimum thicknesses are used as cutoffs to determine ground favorable for ore, about 10% of the Club Mesa area explored can be classified as favorable and contains nearly all the ore reserves discovered. Most of the favorable ground so defined lies in an eastward trending zone ranging from 1,000 to 3,000 ft in width and approximately 2 miles long, extending from the Tramp No. 2 mine on the west to the Club group of mines on the east. About 85% of the ore reserves found by drilling are in this zone. In addition, several smaller areas of favorable ground are present: in sec. 32, between the Barkley and Gardner mines; in sec. 31, east of the Bunker mine; and in secs. 5 and 6, north-northeast of the U. S. Grant mine. Many of these smaller areas have been explored by only a few drill holes and probably will be the most rewarding areas for future exploration. (auth)

HEALTH AND SAFETY

718 CF-54-9-119

Oak Ridge National Lab., Tenn.

THE TIME VARIATION FOR INJURY FROM RADIATION. E. P. Blizard. Sept. 21, 1954. Decl. Sept. 26, 1958. 15p. Contract [W-7405-eng-26]. $3.30(ph OTS); $2.40(mf OTS).

Effects of dose fractionation on radiation injuries are reviewed, and a formulation is presented for relating exposure time to dosage in determination of the maximum safe time for individual members of the crew of nuclear-propelled aircraft. (C.H.)

719 HW-55586

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

RESEARCH AND DEVELOPMENT ACTIVITIES IN THE FIELD OF RADIOLOGICAL SCIENCES. Quarterly Progress Report for January-March 1958. J. W. Healy, ed. Apr. 3, 1958. Decl. Oct. 13, 1958. 47p. Contract W-31-109-Eng-52. $7.80(ph OTS); $3.30 (mf OTS).

The toxicity of reactor effluent under changing concentrations which may occur in the Columbia River as a result of fluctuating river flows when power is produced by Priest Rapids Dam was re-evaluated with young salmon. Data are tabulated. The effect of radioactive elements on aquatic organisms was studied on rainbow trout which were fed P^{32} for 24 weeks. Progress is reported on studies of the effects of small, chronic doses of I^{131} in sheep and swine; strontium metabolism in lambs and miniature pigs using Sr^{89} and Sr^{90} as tracers; the tissue distribution of plutonium in miniature pigs and rats; the effect of dietary calcium level and duration of exposure period on the deposition and retention of Sr^{90} and Ca^{45} in rats; the tissue distribution of Zn^{65} in rats; the histopathological effects of radiation on the intestinal tract; the effect of x irradiation on the DNA content and DNA synthesis in the intestinal tract; the tissue distribution and solubility in body fluids of inhaled radioactive particles; the uptake of radioactive substances by plants; the uptake of Cs^{137} and Zn^{65} by aquatic plants and animals; field studies employing fluorescent pigment tracers on the airborne concentrations of materials emanating from the reactor areas; and the development of an empirical system for forecasting probable trajectories of particles in the atmosphere. Literature surveys were made on w measurements and data on ranges and stopping powers of charged particles. The testing of a slow neutron ionization chamber in a moderated neutron detector indicates the possibility of providing fixed monitors to integrate the fast neutron dose at working locations. Operation of the rock-shield body monitor is reported. Studies of the

geology, hydrology, and soil characteristics of the region were continued with refinement of the techniques involved so that the parameters involved in ground waste disposal can be better defined. (For preceding period see HW-54938.) (C.H.)

720 HW-56582

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

THE INFLUENCE OF LIMESTONE NEUTRALIZATION ON THE SOIL UPTAKE OF Sr^{90} FROM A RADIOACTIVE WASTE. H. L. Brandt and A. E. Reisenauer. Aug. 1958. 17p. Contract [W-31-109-eng-52]. $3.30(ph OTS); $2.40(mf OTS).

The relative order of affinity of the soil for Sr^{90} from wastes prepared in three different ways from an acidic radioactive condensate may be explained on the basis of ion exchange and mass action. The use of calcium carbonate as a neutralizing agent can introduce enough calcium into the solution to greatly inhibit the removal by soil of Sr^{90}. This effect is of importance in the ground disposal of all waste solution containing more than 0.1 MPC Sr^{90}. The proximity of calcium to strontium in the lyotropic series suggests that calcium should compete strongly with strontium for ion exchange sites in the soil even at low concentrations of calcium. The apparent strontium competitor for exchange sites in the soil in the unneutralized condensate is the hydrogen ion. Equilibrium data give some indication that dissolution of calcium from the soil by the acid waste may be militating against greater soil uptake of strontium. The use of sodium hydroxide can effect pH control without introducing any formidable competition for the strontium ion in soil adsorption. This reagent is, therefore, generally superior to limestone for neutralizing acidic radioactive wastes when efficient utilization of the soil for Sr^{90} removal is desired. (auth)

721 IDO-16466

Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.

A STANDARD PRACTICES GUIDE FOR HAZARD ANALYSIS OF EXPERIMENTAL SYSTEMS. R. J. Nertney. Sept. 8, 1958. 28p. Contract AT(10-1)-205. $1.25(OTS).

This guide is to assist experiment sponsors in performing hazard analyses of experimental systems at the MTR and ETR. The requirements for such analyses are described in general terms. (auth)

722 UCRL-8401

California. Univ., Berkeley. Radiation Lab.

FALLOUT AND NATURAL BACKGROUND IN THE SAN FRANCISCO BAY AREA. H. Wade Patterson, Alan R. Smith, and Lloyd D. Stephens. Aug. 4, 1958. 17p. Contract W-7405-eng-48. $0.75(OTS).

Radiation levels have been measured at 30 locations near San Francisco since March 1958. From these measurements it is possible to estimate the amount of fallout deposited and the natural background level. At one location a series of samples was collected and by the use of a NaI crystal the gamma ray spectra were found to be consistent with those emitted from fission products. (auth)

723 UR-532

Rochester, N. Y. Univ. Atomic Energy Project.

STUDIES ON LARGE AREA SUB-FABRIC BURNS. THE EFFECT OF (1) REFLECTANCE AND SEPARATION OF FABRIC, AND (2) TREATMENT WITH FIRE-RETARDANT MATERIAL. Kelly M. Berkley. Aug. 7, 1958. 34p. Contract W-7401-eng-49. $1.00(OTS).

A series of cutaneous burns was produced on swine by exploding 150 mgm of magnesium powder at distances of 20 and 25 cm from the animal. This provided 20 cal/cm^2 at exposure times of 0.7 and 2 to 3 sec and 16 cal/cm^2 at an exposure time of 0.7 sec respectively. The effect of placing green and khaki poplin fabrics untreated and treated with fire-retardant material L-S 123P, in contact with and separated 5 and 10 mm from skin was studied. Burns were evaluated both by surface appearance and by microscopic examination. All the fabrics reduced the severity of the burns. As the amount of separation increased, the severity of the burns decreased if the fabric remained intact. The khaki fabric with its higher reflectance gave more protection than the green fabric at 16 cal/cm^2 at 0.7 sec exposure time and 20 cal/cm^2 at 2 to 3 sec exposure time, but not at 20 cal/cm^2 at 0.7 sec exposure. The fire-retardant treated material gave more protection than the untreated material if it persisted longer during the exposure. If both persisted during the exposure but flaming or flaring occurred, the untreated fabric gave more protection than the treated. (auth)

724 USNRDL-TR-256

Naval Radiological Defense Lab., San Francisco.

PROTECTING AND CLEANING HANDS CONTAMINATED BY SYNTHETIC FALLOUT UNDER FIELD CONDITIONS. R. H. Black. Aug. 27, 1958. 23p.

Hands of field test personnel became radioactively contaminated with dust or slurry synthetic fallouts containing La^{140} tracer, and La^{140} in acid solution. Two protective creams and several cleaning materials were used in an attempt to reduce adherence of contaminant and to facilitate decontamination. The protective creams were not found to be advantageous. Three experimental cleaning solutions (isotonic neutral solution of a complexing agent plus a detergent and germicide; an isotonic saline solution at pH 2.0 plus detergent and germicide; and a 3% citric acid solution) were found to decontaminate skin more readily than soap and water. A waterless mechanic's hand cleaner was found to clean hands with the same effectiveness as soap and water. (auth)

725 UWFL-53

Washington. Univ., Seattle. Applied Fisheries Lab.

RADIOACTIVITY OF INVERTEBRATES AND OTHER ORGANISMS AT ENIWETOK ATOLL DURING 1954-55. Kelshaw Bonham. Jan. 6, 1958. 55p. Contract AT(45-1)-540. $1.50(OTS).

The trend in beta radioactivity as measured with methane flow counters over a period of about two years is shown, starting with the 1954 Castle series of nuclear detonations, up to but not including the series of 1956. The results are presented as graphs each showing the logarithm of the radioactivity of an organism or of a particular tissue of an organism, related to the logarithm of the time after the date of detonation, when nearly all of the radioactivity was assumed to have originated. Invertebrates are considered in greatest detail, and other organisms and materials are included for comparison: island soil, beach sand, sea water, plankton, algae, land plants, reef fish, birds, and rats. It is proposed for most organisms studied that after a period varying with the organism up to two to four weeks following detonation, a maximum level of radioactivity in the field samples collected is attained, followed by a decline approaching linearity on log-log plots with slopes over the major portion of the two-year period that can be represented as the negative exponent of the time after detonation. These decline slopes varied greatly with different localities and organisms, reaching a maximum of

>3. A few decay rates of individual samples of each organism or material are included for comparison, and these generally were equal to, or less steep than, the declines, suggesting that for some organisms or tissues, the level of radioactivity in the environment decreases more rapidly than can be accounted for solely by physical decay while for others the rate of decline can be accounted for solely by the rate of physical decay. Dilution by natural water currents and rain is presumed to account for the many cases of more rapid decline than decay. (See also UFFL-42.)

726

DOSIMETRY OF GAMMA AND X RADIATION AND MONITORING OF RADIOACTIVE AEROSOLS. K. Spurny and H. Kloudova (Univ. of Prague). Pracovni lekarstvi, Praha 10, 167-70(1958). (In Czech.)

Dosimetry of gamma and x radiation and monitoring techniques for detecting radioactive aerosols under industrial and laboratory conditions are described. The gamma and x radiation were measured with a divided ionization chamber with an adapted electrometer. The autoradiographic method was used for measuring radon concentrations in the atmosphere. Diaphragm filters were utilized for capturing the samples of radioactive aerosols. (R.V.J.)

727

THE LINEAR DOSE DEPENDENCE OF SOMATIC RADIATION PROTECTION. P. Kühne, E. Krokowski, and U. Ehling (Univ. of Berlin, Stadtischen Krankenhaus Westend, Berlin, and Max-Planck-Inst., Berlin-Dahlem). Z. Naturforsch. 13b, 626-8(1958) Sept. (In German)

A linear dose effect relation was detected for a somatic radiation protection within a given dosage range. The statistical analysis did not refute the hypothesis of a straight-line path for the dose effect curve up to the zero dose, so that the assumption of a non-harmful threshold dose was not valid. (tr-auth)

728

A CONTAINER FOR THE SIMULTANEOUS STORAGE OF SEVERAL GAMMA-RADIOACTIVE SUBSTANCES. A. K. Kir'yanov. Zavodskaya Lab. 24, 360-1(1958). (In Russian)

A description is given of the design and construction of a storage container for several gamma sources. (J.S.R.)

729

FIRST REPORT OF THE SPECIAL COMMITTEE ON RADIOACTIVITY OF THE GERMAN FEDERAL REPUBLIC. Stuttgart, Georg Thieme Verlag, 1958. 67p. $1.10. (In German)

The first report of the Special Committee on Radioactivity clarifies the present situation in the Federal German Republic with respect to the contamination of air, water, soil, and food material by radioactivity of all sources. In the first part of the report the results of the measurements are given. In the second part of the report an estimation is made of the radiation dose received by the population. (J.S.R.)

INSTRUMENTS

Refer also to abstracts 984, 986, 993, 996, 997, 998, 999, 1000, 1001, 1002, 1003, 1004, 1007, 1023, 1024, and 1034.

730 CREL-776

Atomic Energy of Canada Ltd. Chalk River Project, Chalk River, Ont.

TRANSISTORIZED COUNTING SYSTEMS. 10. A GENERAL PURPOSE TRANSISTOR POWER SUPPLY. F. S. Goulding and R. A. McNaught. Sept. 1958. 13p. (AECL-695). $0.50(AECL).

This report describes a power supply designed to feed transistor circuits employed in the counting system. Output voltages of +30, +15, +10.5, +1.5, and −30 volts are available which do not change by more than ±3% for changes from zero to full load and mains input changes of ±10%. The total output power can be as high as 15 watts distributed approximately equally between positive and negative voltage lines. Stabilization of the output voltages is achieved by controlling the a-c fed to the main power transformer. A transistor amplifier, which operates from an error signal obtained by comparing a Zener reference voltage with one of the output voltages, performs the controlling. (auth)

731 IDO-16370

Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.

CALCULATED EFFICIENCIES OF CYLINDRICAL RADIATION DETECTORS. Stanley H. Vegors, Jr., Louis L. Marsden, and R. L. Heath. Sept. 1, 1958. 83p. Contract AT(10-1)-205. $2.50(OTS).

The results of a calculation for the fraction of gamma rays of energy E which interact with a right cylindrical detector are presented. Three geometrical configurations have been considered. These include a point source located on the extended axis of the detector, a disk source centered on the extended axis with the plane of the disk perpendicular to this axis, and a line source perpendicular to the extended axis of the detector. Results for a point source of radiation are presented in tabular form for 31 different size detectors for a wide range of gamma energy and solid angle. Results for disk and line sources are given for $1\frac{1}{2}''$ diam × $1''$ thick, $1\frac{3}{4}'' \times 2''$, and $3'' \times 3''$ cylindrical detectors. The method of calculation, accuracy, and experimental application of the calculated efficiencies to quantitative gamma ray spectrometry using NaI(Tl) are discussed in some detail. (auth)

732 NACA-TN-4383

Lewis Flight Propulsion Lab., Cleveland.

A COOLED-GAS PYROMETER FOR USE IN HIGH-TEMPERATURE GAS STREAMS. Lloyd N. Krause, Robert C. Johnson, and George E. Glawe. Sept. 1958. 33p.

An immersion-type pyrometer is described which utilizes the controlled cooling of a continuously aspirated sample of the gas whose temperature is to be measured. The gas is cooled as it is drawn through a tube, after which its temperature is measured with a thermocouple. Free-stream total temperature is then obtained by a relation involving internal heat transfer in the tube, gas properties, and certain readily measured temperatures and pressures. Experimental data were obtained with the cooled-gas pyrometer in a 2000 to 4000°R gas stream. (auth)

733 NRL-5150

Naval Research Lab., Washington, D. C.

A NEW THERMAL CONDUCTIVITY LEAK DETECTOR AND ITS APPLICATIONS. Clarke C. Minter. Apr. 25, 1958. 8p. Project No. NS-131-004.

This report points out the reasons for the failure of the Pirani tube as a sensitive leak detector and describes a simple thermal conductivity apparatus of special design having several advantages over the mass spectrometer so widely used for this purpose. Procedures are described for using the new apparatus to locate leaks in vacuum or pressure systems using hy-

drogen or helium as probe gas. Experiments to determine the sensitivity of the apparatus toward small changes in concentration of freon in air are described, and it has been concluded that leaks in refrigeration equipment can be located even when appreciable concentrations of freon are present in the ambient air. (auth)

734 SCR-48
Sandia Corp., Albuquerque, N. Mex.
A TRANSISTORIZED CURRENT-CONTROLLED OSCILLATOR FOR DC-EXCITED STRAIN GAGE APPLICATIONS. C. E. Land. Sept. 1958. 53p. Contract AT(29-1)-789. $9.30(ph OTS); $3.60(mf OTS).

The Transistorized Current-Controlled Oscillator (TCCO) is a practical device for providing a frequency modulated signal directly proportional to the appropriate excitation phenomena such as stress, pressure, acceleration, and in some instances, temperature. The unit was designed primarily for airborne FM-FM telemetry applications. The TCCO is simple from the standpoint of number of parts. It consists of only three functional components: the DC amplifier, the variable inductor, and the oscillator. Each of the functional components was designed to provide maximum reliability and stability of operation. The use of transistors, a subminiature toroidal inductor, and printed wiring have made possible a compact, rugged, low-cost unit with extremely low power requirements. The TCCO provides a unique method of converting the output of a resistance bridge transducer to a proportional frequency modulated signal with the required accuracy and stability. (auth)

735 SCTM-318-58(16)
Sandia Corp., Albuquerque, N. Mex.
A CAPACITIVE MANOMETER. O. D. Neece. Aug. 29, 1958. 13p. Contract AT(29-1)-789. $3.30(ph OTS); $2.40(mf OTS).

The construction and operation of a capacitive manometer, a device which operates on the principle of a variable pressure changing the electrical capacitance of a manometer tube, are discussed. The variation of the capacitance of the manometer changes the frequency of an oscillator which is monitored with a Berkeley counter. The result is a different counter display for each pressure applied to the manometer. The repeatability of the device is shown. (auth)

736 SCTM-332-58(14)
Sandia Corp., Albuquerque, N. Mex.
THEORY OF COUPLED FOLDED ANTENNAS. C. W. Harrison, Jr. Sept. 3, 1958. 18p. Contract AT(29-1)-789. $3.30(ph OTS); $2.40(mf OTS).

Formulas for the mutual and self-impedance of two identical nonstaggered parallel folded dipoles are developed. Through the use of examples it is shown how the theory may be generalized to permit determination of these impedances for any identical dual configuration of wires, no matter how complicated, provided the structures are symmetrical with respect to the driving points. Two obvious uses of the theory are (a) the determination of the performance of a two-element folded antenna array, when one antenna is a tuned parasite, functioning as a director or reflector, and (b) determination of the driving-point impedance of a folded antenna parallel to a conducting plane. (auth)

737 WAPD-PWR-Ph-146(Del.)
Westinghouse Electric Corp. Bettis Plant, Pittsburgh.
COMPARATIVE THERMAL FLUX DISTRIBUTIONS, Mn VS. U^{235} DETECTORS. R. F. Valentine. Nov. 13, 1956. 8p. $1.80(ph OTS); $1.80(mf OTS).

An experiment was performed on a water-reflected slab reactor with central water channel to determine whether a thermal flux traverse as measured with manganese detectors differs from that obtained with U^{235} detectors. The flux distribution was determined across the narrow dimension of the core by measuring the induced beta-ray activity in Manganin wire, and by measuring the beta activity of the fission products produced by irradiation of U^{235}–Zr wire. Epi-cadmium flux was measured by the irradiation of wires covered with 0.016 in. thick cadmium tubing. (W.D.M.)

738
NUCLEAR RESONANCE OSCILLATOR OPERATING IN THE MAGNETIC FIELD OF THE EARTH. F. I. Skripov (Zhdanov Leningrad State Univ.). Doklady Akad. Nauk S.S.S.R. 121, 998-1000(1958) Aug. 21. (In Russian)

The design presented employs a reception coil which contains a portion of a sample with its precession vector of nuclear magnitization deflected at 90° from the direction of the terrestrial field. The vector deflection is effected by means of an alternating field with resonance frequency and a pair of deflecting (phasing the nuclear precessing) coils which are fed from the free induction signal in the receiving coil. The generated frequency automatically records the intensity of the measured magnetic field. (R.V.J.)

739
MASS SPECTROMETER WITH A HIGH RESOLVING POWER. N. E. Alekseevskii. Vestnik Akad. Nauk S.S.S.R. 28, No. 6, 67-9(1958) June. (In Russian)

A scheme is offered for a high resolving power mass spectrometer in which the diverging ionic beam converges into a narrow line only in instances when the beam is turned at < 180°. The magnitude of the angle in such focusing increases with the increase of inhomogeneity of the field. (R.V.J.)

740
A DEVICE FOR THE INVESTIGATION OF THE CORROSION AND ELECTROCHEMICAL BEHAVIOR OF METALS UNDER THE ACTION OF IONIZING RADIATION. I. L. Rozenfel'd and Ye. K. Oshe. Zavodskaya Lab. 24, 346-8(1958). (In Russian)

A description is given of an electrolytic cell which is used to determine the effect of ionizing radiation of the corrosion and electrochemical behavior of metals. The metals being investigated are used as anode and cathode. A measurement of the amperage indicates the course being taken by the corrosion. The investigation shows that irradiation of a cathode sample causes corrosion to increase rapidly, but irradiation does not increase the corrosion of an anode sample. Data from measurements on zirconium–iron are given. (J.S.R.)

741
ATOMIC RADIATION GEIGER COUNTERS. Heinz Richter. Stuttgart, Franckh'sche Verlagshandlung, 1957. 218p. (In German)

This book is intended as an introduction to the field of radiation measuring devices and techniques. A discussion of radioactive materials, radiations, and substances serves as an introduction to a brief survey of electronic radiation producers such as the x-ray tube or the betatron. The techniques and instruments used in the electronic measurement of radioactivity are broadly surveyed. A short closing chapter deals with application of radioactive radiations and materials. (J.S.R.)

742
TECHNOLOGY OF INSTRUMENTATION. Eric B. Pearson. Princeton, N. J., D. Van Nostrand Company, Inc., 1957. 197p.

This book, designed as a textbook for undergraduates or as an introduction to instrumentation, presents the principles of instrument design. The topics discussed include basic principles of measurement, basic characteristics of measuring instruments with a moving element, dynamic accuracy of an instrument, laboratory techniques for measuring the response characteristics of instrument movements and simple servomechanisms, instrumentation applied to control processes, improvement of servomechanism performance, stability criteria for linear servomechanisms, components used in servomechanism layouts, and instrumentation of mathematics. (J.S.R.)

743

COMPUTER ENGINEERING. S. A. Lebedev, Ye. N. Grigor'yev, and T. A. Prusakova, eds. Moscow, Izd-vo AN SSSR, 1958. 150p. (In Russian)

A number of problems of computer engineering are discussed in this collection of articles. The power supply system of high-speed electronic computers of the USSR Academy of Sciences, new computer components and devices, and methods of controlling arithmetic units are covered. Methods of selecting the necessary word from the mechanical dictionary in machine translation and the terminology of modern computing machines are also presented. The book is intended for specialists engaged in the design and use of electronic computers. (J.S.R.)

METALLURGY AND CERAMICS

Refer also to abstracts 982, 990, 991, 1005, 1026, and 1028.

744 55-RL-1234

General Electric Co. Research Lab., Schenectady, N. Y.

THERMOELECTRIC STABILITY OF THERMOCOUPLE MATERIALS AT ELEVATED TEMPERATURES. J. M. Berry and D. L. Martin. Mar. 1955. 30p.

A study of the thermoelectric stability of ten metallic materials was made. In the experimental technique used, the materials were aged isothermally at 780°C, and each material was individually evaluated by comparison with platinum at the steam and zinc melting temperature reference points. The results are believed to be more suitable for the evaluation of thermoelectric stability than are results obtained by testing materials under gradient conditions as thermocouples. In addition, the isothermal results can be used to estimate the performance of thermocouples. It is also concluded that a stabilization treatment prior to use will improve the stability of some base metal thermocouples. The effects of aging in air and in a vacuum were studied. Scatter in the data obtained from vacuum-aged specimens suggests that optimistic assumption about the efficacy of "protective" atmospheres may be unjustified. Very pure nickel and silver are quite stable in air at 780°C. This combination makes a thermocouple which, even after long periods of use, is relatively insensitive to changes in temperature distribution. (auth)

745 AECD-4271

Los Alamos Scientific Lab., N. Mex.

CRITICAL STRAIN VALUE FOR ALPHA RECRYSTALLIZED ROLLED URANIUM SHEET. Gale S. Hanks. [1957]. Decl. Sept. 13, 1957. 24p. Contract [W-7405-eng-36]. $4.80(ph OTS); $2.70(mf OTS).

The percentage strain at which, or immediately higher than which, grain growth occurs on cold-worked alpha-recrystallized uranium sheet appears to be at approximately 2.5% reduction in thickness. Grain growth from 20 μ to over 150 μ has been indicated for this region. These phenomena are especially noteworthy when deep drawn uranium shapes are to be reheated for a coining or restriking operation. (auth)

746 AECD-4273

Los Alamos Scientific Lab., N. Mex.

TRANSFORMATION CHARACTERISTICS OF LOW TERNARY ALLOYS OF URANIUM. Daniel J. Murphy. [1956]. Decl. Feb. 11, 1957. 36p. Contract [W-7405-eng-36]. $6.30(ph OTS); $3.00(mf OTS).

A series of ternary additions of niobium, platinum, and molybdenum, of the order of 1.0 wt. % and less, was made to binary uranium—0.5 wt. % titanium, an alloy of some promise in the γ-heat-treated, water-quenched condition. Jominy bars of nine such alloys were tested, microstructurally examined, and hardness profiles obtained over their length. Observations were made for correlation of transformation behavior, microstructure, and hardness profiles over the spectrum of cooling rates experienced, directed toward determining the effect of ternary additions in improving the properties of uranium. (auth)

747 AECU-3848

Utah. Univ., Salt Lake City. Inst. for the Study of Rate Processes.

EFFECT OF OXIDE ADDITIONS ON THE SINTERING OF MAGNESIA. Technical Report No. II. James W. Nelson and Ivan B. Cutler. June 1, 1956. 48p. Contract AT(11-1)-82. (M-5953). $7.80(ph OTS); $3.30 (mf OTS).

The effect of transition, alkali, alkaline earth and heavy metal oxide additions on the sintering of magnesia was determined by measurements of bulk densities and shrinkages. Zirconium dioxide and the transition metal oxides were found to increase the bulk densities, especially in the region of low sintering temperatures. The alkali, alkaline earth and the volatile heavy metal oxides hindered low temperature sintering. (auth)

748 AERE-M/R-2544

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

INTERDIFFUSION BEHAVIOUR OF COPPER AND URANIUM. I. J. Bear and A. D. Le Claire. June 1951. Decl. Sept. 1957. 21p. $0.63(BIS).

Declassified and amended version of AERE-M/R-721.

A method for measuring the rates of interdiffusion of copper and uranium and the results obtained by the method are discussed. The technique is one applicable to a study of the interdiffusion of any two metals with small ranges of solubility in each other. Preliminary experiments were designed to obtain good cohesion between copper and uranium. Of these, the methods of electroplating and hot rolling gave poor results, but that of hot pressing uranium powder on to copper disks at 760°C and under a pressure of 10 tons/sq in. proved to be very satisfactory. Diffusion anneals were carried out in a vacuum at various temperatures and the rates of diffusion determined by measuring the rate of advance of the phase boundary into each metal together with the rate of increase in the total width of the diffusion band. Subsidiary observations of the phases present in the uranium copper system indicated that besides the elements themselves there are at least two other primary phases present in the system at the temperatures employed in the diffusion anneals. (auth)

749 BMI-1286

Battelle Memorial Inst., Columbus, Ohio.

PROGRESS RELATING TO CIVILIAN APPLICATIONS DURING AUGUST 1958. Russell W. Dayton and Clyde R. Tipton, Jr. Sept. 1, 1958. Decl. Oct. 15, 1958. 48p. Contract W-7405-eng-92. $7.80(ph OTS); $3.30(mf OTS).

Measurements of thermal conductivity and electrical resistivity were continued on irradiated specimens of UO_2-clad in Zircaloy-2 with NaK as the heat-transfer medium. The creep strength of 0.15% cold-worked Zircaloy-2 is being determined at elevated temperatures. Work continued on the development of high-strength corrosion-resistant Zr alloys. Research to develop a method of sink-float density measurements to identify factors affecting irradiation-induced volume changes in graphite was continued. Single crystals of high-purity Mo are being prepared for irradiation damage studies. Casting methods are presented for Al–U alloys. Time-temperature relationships are being studied during the solidification of small cylindrical U castings to improve the quality of fabricated U fuel slugs. Methods for preparing a thin protective coating of Mo on Croloy are being investigated. Research indicates that in a binary system of $UO_2-La_2O_3$ about 60 wt. % La_2O_3 is required to form a stoichiometric structure after oxidation. Investigations of the hydrides of U–Zr alloy for possible use in gas-cooled reactors were continued. An irradiation-damage program on type 347 stainless steel was undertaken to study the changes in physical properties that are caused by continued exposure to a fast-neutron flux up to 3×10^{15} nvt and integrated flux levels of 14 to 16×10^{22} nvt. Studies on the properties of Nb–U alloys and the effect of impurities on these properties are presented. Studies on developing Th–U alloys with improved irradiation stability and corrosion resistance are reported. Fabrication techniques for producing dispersion fuel elements with cores of 60 to 90 vol. % UO_2, UN, or UC dispersed in stainless steel, Mo, Nb, and Cr are being investigated. Gas-pressure bonding of Mo- and Nb-clad fuel elements is presented. Work was continued on fatigue studies of Inconel. No severe attack of Ti specimens was observed in any of the studies involving Darex Process solutions. Stress-relief treatments were not effective in improving the corrosion resistance of Carpenter 20 Cb to Sulfex–Thorex solutions. Studies of the fluoride-volatility process have shown fairly high corrosion rates. Casting techniques, irradiation-capsule design, and fission-product release from irradiated UC are presented. The postirradiation examination of fuel element OMRE-3 is approaching completion. Creep data are presented on thermally degassed fine-grained sintered Ta sheet tested at 1200°F in a He atmosphere. Mixing studies of a model of the PWR core have been resumed. Some improvements were found from the use of deflector vanes over each inlet. In the Maritime Gas Cooled Reactor program a study is under way to investigate the effects of radiation on the reactions of stainless steel cladding with CO_2 and graphite. The Nuclear Merchant Ship Reactor development program is concerned with testing prototype UO_2 fuel pins under anticipated NMSR reactor conditions in the MTR. (For preceding period see BMI-1280.) (W.L.H.)

750 CF-56-4-123(Del.)

Oak Ridge National Lab., Tenn.

THE EXTRUSION OF COMPOSITE TUBES. Speech for AEC Metallurgical Information Meeting, Ames, Iowa, May 2-4. M. R. D'Amore and H. Inouye. Apr. 18, 1956. Decl. with deletions Apr. 3, 1958. 24p. Contract [W-7405-eng-26]. $4.80(ph OTS); $2.70(mf OTS).

The extrusion of seamless tubular fuel elements and seamless tubes is discussed. (W.L.H.)

751 CRMet-794

Atomic Energy of Canada Ltd. Chalk River Project, Chalk River, Ont.

CREEP OF MAGNESIUM ALLOY AZ80-T5 AT LOW TEMPERATURES. L. G. Bell. Sept. 1958. 24p. (AECL-689). $0.50(AECL).

Magnesium alloy AZ80 (Mg–8.5 Al–1.0 Zn–0.25 Mn) in the T5 or age hardened condition was creep tested at 50°C and at various stresses. Creep rates were measured at the termination of tests which lasted from 600 to 1000 hrs. Extrapolation of the results show that a creep rate of 10^{-5}%/hr is obtained at a stress of 10,000 psi. (auth)

752 CWR-477

Curtiss-Wright Corp. Research Div., Quehanna, Penna.

CONDENSED INFORMATION ON HIGH-TEMPERATURE MATERIALS. Aug. 29, 1957. 77p.

Information is summarized on 37 high-temperature materials. Data are included on chemical composition, physical properties, mechanical properties, thermal properties, the possible supplier, and references stating the source of the information. (C.H.)

753 IGR-TN/C-583

United Kingdom Atomic Energy Authority. Industrial Group. Culcheth Labs., Culcheth, Lancs, England.

THE TENSILE PROPERTIES OF NIOBIUM. H. G. Vaughan and R. G. Rose. July 11, 1958. 22p.

The tensile properties of $\frac{1}{8}$-in. thick annealed niobium sheet were measured over the temperature range 20 to 500°C. Strip, 0.04-in. thick, obtained by cold rolling $\frac{1}{8}$-in. thick annealed niobium sheet, was tensile tested in the cold-worked and annealed conditions. Results show that niobium retains its strength up to 500°C, while the elongation decreases to a minimum at 500°C. It was found that production niobium is susceptible to strain aging at temperatures above 350°C. The effect of surface oxidation on the ultimate tensile strength of niobium was examined and results reported on the tensile properties of niobium–oxygen alloys. Surface oxidation, at the times and temperatures considered, does not alter the room-temperature tensile strength, while oxygen in solution in niobium increases the ultimate tensile strength and emphasizes the brittle nature of fracture at 500°C. (auth)

754 ISC-1037

Ames Lab., Ames, Iowa.

BRITTLE-DUCTILE TRANSITION IN VANADIUM. Benny A. Loomis and O. N. Carlson. Mar. 1958. 102p. Contract W-7405-eng-82. $2.50(OTS).

Mechanical tests were made on two grades of vanadium over a range of temperatures below 25°C to establish the existence of a brittle-ductile transition and the temperature range over which it occurs. Also, the effect of small amounts of metallic and nonmetallic additions on the brittle-ductile transition in vanadium was determined. Some of the physical properties of vanadium were determined through the transition temperature. The results and conclusions of this investigation are summarized. (auth)

755 KAPL-M-AL-1

Knolls Atomic Power Lab., Schenectady, N. Y.

FABRICATION OF CRITICAL ASSEMBLY COMPONENTS FROM NON-REACTOR GRADE AND SCRAP ZIRCONIUM AND ZIRCALOY. A. Levy, A. R. Kephart,

and C. P. Matuszyk. May 21, 1958. 26p. Contract W-31-109-Eng-52. $4.80(ph OTS); $2.70(mf OTS).

A group of non-reactor grade ingots and ingots melted entirely from scrap was fabricated into core components for a zero power critical assembly. Problems were resolved relative to the mill fabrication of material with non-uniform composition and hardness. Methods were devised which enabled the suitable and economical working and construction of core components. Data on nuclear, mechanical, and corrosion properties were correlated with ingot composition, hardness, and mill fabrication techniques. (auth)

756 KAPL-M-AME-13

Knolls Atomic Power Lab., Schenectady, N. Y.
DEVELOPMENT OF THE S3G Ra–Be SOURCE CAPSULE CLOSURE WELD AND THE S3G SOURCE ROD ASSEMBLY WELDS. Edward Bulson, Albert Ciancetta, and George Smith. July 9, 1958. 10p. Contract W-31-109-Eng-52. $1.80(ph OTS); $1.80(mf OTS).

The prime S3G source capsule and source rod were successfully fabricated by welding techniques without hot lab facilities. Development disclosed that control of the fit between parts and the welding atmosphere was vital to provide welds meeting requirements. (auth)

757 KAPL-M-JLJ-1

Knolls Atomic Power Lab., Schenectady, N. Y.
STATISTICAL METHOD FOR PARTICLE SIZE AND DISTRIBUTION MEASUREMENTS OF BORON CARBIDE PARTICLES DISPERSED IN ZIRCALOY. J. L. Jellison. Sept. 9, 1958. 16p. Contract W-31-109-Eng-52. $3.30 (ph OTS); $2.40(mf OTS).

A statistical procedure was developed in order that post-irradiation particle sizes and volume percents of boron carbide dispersed in Zircaloy might be found. The samples examined were roll-bonded, plate-type burnable poison elements containing two meat sections of boron carbide particles dispersed in Zircaloy-2 per plate. The transverse sections are obtained by cutting a short section from the plate. Two longitudinal cross sections at right angles to one another are made in the sampling of the plates. (W.L.H.)

758 MND-DB-2523

Martin Co. Nuclear Div., Baltimore.
DEVELOPMENT OF IRON–ALUMINUM BASE ALLOYS FOR GAS COOLED REACTOR COMPONENTS. Quarterly Progress Report No. 3 [for] June through August 1958. Frank Tate. Sept. 1958. 41p. Contract AT[30-3]-325. $6.30(ph OTS); $3.00(mf OTS).

A statistically designed experiment consisting of nine melts was carried out to determine the main effects of Zr, Nb, and Mo in a base alloy of Fe–Al and Cr. Additions of Zr, Nb, and Mo increases the stress rupture life of the base alloys. Zirconium had a deleterious effect on oxidation resistance of the base alloy samples tested at 1650 and 1800°F and Nb had a beneficial effect at 1800°F. Zirconium improves the high temperature yield strength of the base alloy. The room temperature ductility of the base alloy decreases with increasing additions of Zr and Nb. (W.L.H.)

759 NBS-5946

National Bureau of Standards, Washington, D. C.
THE URANIUM–PLATINUM SYSTEM. Final Report. J. J. Park and D. P. Fickle. June 19, 1958. 31p. NBS Project 0802-11-4100. $1.00(OTS).

The purpose of this investigation was to make a survey of the uranium–platinum system and to develop the constitution diagram by correlation of data obtained by thermal analysis, x-ray-diffraction, and microscopic analysis. (auth)

760 NMI-1208

Nuclear Metals, Inc., Cambridge, Mass.
THE CORROSION OF ZIRCONIUM ALLOYS IN 900°F STEAM. J. Paul Pemsler. Aug. 18, 1958. 24p. Contract AT(30-1)-1565. $0.75(OTS).

Steam at 900°F is a very corrosive medium for zirconium alloys. Zircaloy-2 and Zircaloy-3 have poor resistance at this temperature. The presence of tin is highly detrimental to the corrosion resistance of zirconium alloys. Additions of nickel, chromium, and to a lesser extent, iron extend the life of zirconium-base alloys to as long as sixty days before spalling commences. Quenching from the beta phase impairs the corrosion resistance of nickel and chromium alloys and extends the life of iron alloys and the Zircaloys. In general, a pre-treatment of 10 days in 680°F water has no effect on the corrosion resistance of the alloys tested. (auth)

761 NRC-MT-38

National Research Council of Canada. Div. of Mechanical Engineering, Ottawa.
THE CONTACT ANGLES OF SOME BISMUTH–RUBIDIUM ALLOYS ON URANIUM DIOXIDE. E. H. Dudgeon. June 4, 1958. 9p.

The effect of the addition of rubidium to bismuth on the contact angle with uranium dioxide was investigated by the sessile drop method. No significant reduction in contact angle was observed with up to 3½% rubidium in bismuth. (auth)

762 ORNL-2372

Oak Ridge National Lab., Tenn.
THE ANNEALING BEHAVIOR OF COLD-ROLLED NIOBIUM (thesis). J. P. Page. Oct. 1, 1957. 98p. Contract W-7405-eng-26. $15.30(ph OTS); $5.40(mf OTS).

Submitted to the Univ. of Tennessee.

The recrystallization behavior of niobium is in agreement with classical recrystallization theory in that recrystallization is promoted by increasing annealing temperature, increasing annealing time, and increasing "prior deformation." Drawings are presented which show, semi-quantitatively, the relative effects of annealing time, annealing temperature, and prior deformation on the initiation and termination of recrystallization. Graphs showing the effects of one-hour anneals on the room temperature tensile properties of cold-rolled niobium are presented. Although otherwise inconclusive, hardness data are presented which indicate that minor degrees of contamination have a marked effect on the hardness of niobium and that hardness is, therefore, a poor criterion for determining recrystallization in niobium. Photomicrographs showing 80% cold-rolled powder-metallurgy and arc-cast niobium after one-hour anneals at room temperature (no anneal), 900, 1000, 1100, and 1200°C, and after fifteen-minute, two-hour, and ten-hour anneals at 1000 and 1100°C are presented. These show the recrystallizing powder-metallurgy niobium to have a finer grain size than the recrystallizing arc-cast niobium after identical treatment. Other than the recrystallized grain size, no significant differences were noted in the annealing behavior of arc-cast and powder-metallurgy niobium. The room temperature tensile properties of the two materials also exhibit no significant differences. (auth)

763 SEP-250

Sylvania Electric Products Inc. Research Labs., Bayside, N. Y.
FUNDAMENTALS OF SINTERING—III. Third Annual Progress Report for June 30, 1957 to June 30, 1958. A. L. Pranatis, L. S. Castleman, and L. Seigle.

June 30, 1958. 30p. Project No. 1852. Contract AT(30-1)-2102. $1.00(OTS).

The influence of the presence of grain boundaries on the rates of sintering of nickel, copper and iron wire wound compacts was studied. In iron compacts sintered in the alpha range, surface diffusion appears predominant and no grain boundary effect is therefore expected or evident. On the other hand, sintering of copper and of nickel compacts at temperatures close to their respective melting points apparently occurs by volume diffusion but with varying grain boundary effects. Neck growth in both materials appears entirely unaffected by the presence or absence of grain boundaries. Void shrinkage was found to be sharply inhibited in nickel samples from which grain boundaries had been deliberately eliminated, but no definite effect was noticed in copper, in apparent contradiction to previous results. (auth)

764 SEP-251

Sylvania Electric Products Inc. Research Labs., Bayside, N. Y.

FUNDAMENTALS OF DIFFUSIONAL BONDING—III. Third Annual Progress Report for June 30, 1957 to June 30, 1958. L. S. Castleman and L. Seigle. June 30, 1958. 28p. Project No. 1853. Contract AT(30-1)-2102. $0.75(OTS).

An investigation has been begun of interdiffusion in the aluminum-uranium system and of the effects thereon of applied pressure. In confirmation of the results of other investigations, it has been found that UAl_3 layer growth is accelerated by increasing applied pressure. The growth kinetics are characterized by a "transient" period, during which growth occurs non-parabolically, which is followed by a "steady state" period of parabolic growth. Interesting correlations are shown to exist between annealing time, annealing temperature, and applied pressure on the one hand, and the nature and distribution of structural defects in the UAl_3 diffusion zone. (auth)

765 WADC-TR-56-184(Pt. 3)

Battelle Memorial Inst., Columbus, Ohio.

THE PRINCIPLES OF DISPERSION HARDENING WHICH PROMOTE HIGH-TEMPERATURE STRENGTH IN IRON-BASE ALLOYS. Period Covered: March 1, 1957 to February 29, 1958. Ervin E. Underwood, Alan K. Wolff, Lyle L. Marsh, and George K. Manning. Apr. 9, 1958. Project title: SOLID STATE RESEARCH AND PROPERTIES OF MATTER. Task title: INTERACTIONS, IMPERFECTIONS, AND ALLOY THEORY. Contract AF33(616)-2785. (AD-155655).

Eleven alloys, based on iron–18% chromium, were prepared with up to 16% nickel so that the α-, $\alpha+\gamma$-, and γ-phase fields were represented. Creep, tensile, and hardness measurements were obtained between 80 and 1700°F. The "plasticity reserve" of Ivanova (rupture time times minimum creep rate) and the empirical relation of Monkman and Grant (between rupture time and minimum creep rate) are examined from a common viewpoint. Both compositional and temperature dependences are established in their relationships. The combined stress-time function is applied to isochronous stress-strain curves out to strains of 30%. Curves of plasticity reserve, ductility at fracture, break (equicohesive) temperature, and the constants in the Rabotnov and Larson-Miller parameters are shown to be related. The strength and stability of the alloys are examined with reference to their break temperatures. The strength of single-phase alloys varies with break temperature, but two-phase alloys show no simple dependence. The "hardening influence" of titanium, beryllium, manganese, cobalt, and nickel solutes reveals both solution hardening and solution softening at elevated temperatures. An opposite strain-rate effect is apparent on the ductility at fracture of α and γ alloys. The strength-hardness correlation proposed earlier has been verified with Alloy S-590 over wide ranges of stresses, times, and temperatures. An inversion in the relative strengthening ability of alloys with coarse and fine spacings appears to conform to the scheme advanced by Giedt, Sherby, and Dorn. (auth)

766 WAL-TR-401/288

Watertown Arsenal Lab., Mass.

EFFECT OF DECOMPOSITION OF BETA TITANIUM ON SELECTED MECHANICAL PROPERTIES. Marvin M. Turkanis and Donald C. Buffum. Oct. 1958. 31p. DA Project 593-32-003.

Two beta stabilized titanium alloys, Ti-FeCrMo and Ti-Mn, were studied. Hardness, when plotted as a function of tempering temperature, passes through a double peak, which is accentuated by increasing the tempering time. The specimens tempered in the lower temperature peak (hypopeak) region showed no apparent metallographic change, while those tempered in the higher temperature peak (hyperpeak) region showed increasing amounts of fine alpha precipitation with increasing temperature. (auth)

767 WAPD-NCE-7009

[Westinghouse Electric Corp. Bettis Plant, Pittsburgh.]

PRODUCTION OF ZIRCALOY-2 TUBING FOR THE PWR BLANKET. J. G. Goodwin. Nov. 27, 1957. 15p. $3.30 (ph OTS); $2.40(mf OTS).

The development work required to overcome the difficulties encountered in extrusion, tube reduction, drawing, annealing, etc., in the production of small diameter Zircaloy-2 seamless tubing in large quantities for the Shippingport Pressurized Water Reactor is described. The seamless technology based on extruded tube shells, tube reducing, and drawing was the primary effort and eventually became the method used for production. (W.D.M.)

768 WAPD-PWR-FEm-106

[Westinghouse Electric Corp.]. Bettis Plant, Pittsburgh.

PREPARATION OF URANIUM ALLOYS BY MELTING. W. B. Haynes and F. R. Lorenz. Feb. 16, 1956. Decl. Oct. 2, 1958. 20p. $3.30(ph OTS); $2.40(mf OTS).

Methods of melting uranium and its alloys are examined including vacuum induction melting and consumable and non-consumable electrode arc melting. The equipment and procedures are outlined with the limitations and uses of each method. In addition, the preparation and properties of Al–U, Cr–U, Mo–U, U–Nb, U–Si, and U–Zr, and Nb–U–Zr alloys are described. Special techniques of agitation during freezing to produce fine castings are listed along with a discussion of the advantages of centrifugal casting. (J.R.D.)

769 WAPD-Re-V(A)-30

Westinghouse Electric Corp. Atomic Power Div., [Pittsburgh].

A LITERATURE SURVEY ON CAUSES OF BALL BEARING FAILURE IN COMMERCIAL APPLICATIONS. C. S. Galtz. Aug. 7, 1953. Changed from OFFICIAL USE ONLY Jan. 16, 1958. 28p. $4.80(ph OTS); $2.70 (mf OTS).

The causes of ball bearing failure are discussed, including dirt, inadequate lubrication, and high loads introduced by improper mounting of the bearing. The corrosion mechanisms such as chemical attack and

fretting are considered, along with failure caused by defects and failures in which the general bearing performance is unsatisfactory. (J.R.D.)

770 WAPD-SFR-Ch-138

Westinghouse Electric Corp. Atomic Power Div., Pittsburgh.

CORROSION OF MATERIALS IN LITHIUM HYDROXIDE SOLUTION AT 600°F FOR 1500 HOURS. Richard W. Barret. 1955. Changed from OFFICIAL USE ONLY Mar. 14, 1958. 27p.

Corrosion of STR materials, in general was less in lithium hydroxide solution at 600°F than was reported for exposure at 500°F in SFR reference water containing 1 to 5 ppm NH_3. Stainless steels 304 annealed, 347 annealed, and 347 sensitized all exhibited approximately the same total (descaled) corrosion of approximately 23 mg/dm^2 on exposure for 1500 hr. These results should be compared with total corrosions after 1500 hr in SFR reference water of 97, 90, and 78 mg/dm^2, respectively, for these materials. Type 410 stainless steel was the poorest STR material tested with the exception of copper; however, in lithium hydroxide the total weight loss of 410 SS was 65 mg/dm^2 after 1500 hr compared with 77 mg/dm^2 in SFR reference water. Copper was the only material tested which did not show a reduction in corrosion rate as the test progressed. For this material the lowest weight loss (2.6 mg/dm^2) was observed during the first 250 hr of exposure and was followed by a sharp rise to a total weight loss of 99.7 mg/dm^2 at 1500 hr. Carbon steel corrosion for all specimens was characterized by rapid attack and scale build-up during the first 250-hr period. This was followed by relatively mild corrosion during the remaining 1250 hr of the test. Monthly total corrosion rates during the first 250 hr period ranged from 729 mg/dm^2/mo to 636 mg/dm^2/mo. In the exposure period from 1000 to 1500 hr, the total corrosion rates ranged from 37.4 mg/dm^2/mo to 11.5 mg/dm^2/mo. The Croloys, chromium alloy steels, also exhibited rapid early attack followed by reduced later corrosion. The 1¼ and 2¼% chromium contained in Croloys CR-1 and CR-2 did not make these materials noticeably superior to carbon steels; however, the 5% chromium in CR-5 resulted in an alloy whose average corrosion was about 50% that of carbon steel. (auth)

771 SCL-T-204

THE MARTENSITE TRANSFORMATION IN THE COPPER–ZINC SYSTEM. (Die Martensitumwandlung in System Kupfer–Zink). Guido Bassi and Bengt Ström. Translated by Marcel I. Weinreich (Sandia Corp.) from Z. Metallkunde 47, 16-21(1956). 12p.

The stability of the β_1 lattice diminishes with increasing copper content transforming to α by diffusionless translation. With lower copper content β_1 is obtained by the same mechanism of transformation. Additions of lead and bismuth lead to martensite-like structures. The results are discussed. (auth)

772

DECORATION OF THE DISLOCATION LINES BY PRECIPITATES IN AN ALUMINUM–4% COPPER ALLOY AGED AT 250°C. Pierre A. Jacquet, Adrienne R. Weill, and Jean Calvet. Compt. rend. 247, 1001-2 (1958) Oct. 6. (In French)

In an alloy brought back to 250°C for 15 min after tempering, the beginning of the precipitation of the Al_2Cu (θ') phase can be detected in the joints of the grain, along the slip lines, and at the multiplicative sources of dislocations. The calculation shows that the constraints of tempering extend slightly the limit of elasticity. (tr-auth)

773

STUDY OF THE EFFECT OF THE AGING TEMPERATURE ON THE PRECIPITATION OF CARBON IN PURE IRON BY MEASUREMENT OF THE ELECTRIC RESISTIVITY AT VERY LOW TEMPERATURES. Bernard Migaud. Compt. rend. 247, 1003-5(1958) Oct. 6. (In French)

In a preceding article (Compt. rend. 246, 425(1958)) it is shown that the electric resistivity at very low temperatures shows a particular form of the precipitation of carbon dissolved in the α-iron after aging at 67°C. It is shown that for higher temperatures of aging the precipitation is made in two stages. This phenomenon is particularly clear in the neighborhood of 150°C. (tr-auth)

774

ANODISING BATH FOR MAGNESIUM ALLOYS. M. W. Davies (General Electric Co., Ltd.). Corrosion Technol. 5, 281-4(1958) Sept.

A brief review of the protective coatings available for magnesium alloys is presented, including details of a chromate process called New Chrome. Results of New Chrome corrosion inhibition tests are reported, and the protective coatings are compared to those produced by the H.A.E. process. (J.R.D.)

775

DIFFUSION MOBILITY AS INFLUENCED BY IRREVERSIBLE STRUCTURAL MODIFICATIONS DUE TO PLASTIC DEFORMATION. S. Z. Bokshtein, T. I. Gudkova, A. A. Zhukhovitskii, and S. T. Kishkin (All-Union Scientific Research Inst. of Aviation Materials). Doklady Akad. Nauk S.S.S.R. 121, 1015-18(1958) Aug. 21. (In Russian)

The effects of plastic deformation on the diffusion of tin in nickel at 800°C were studied. (R.V.J.)

776

ACTIVATION ENERGY VALUES FOR SPONTANEOUS DIFFUSION IN LIQUID METALS. K. A. Osipov (Baikov Inst. of Metallurgy, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R. 121, 1019-20(1958) Aug. 21. (In Russian)

An equation was formulated for expressing the activation energy values for spontaneous diffusion and viscosity of liquid Al, Fe, Mg, Na, Pb, and Sn. (R.V.J.)

777

THE SOLUBILITY OF CARBON IN ALPHA-IRON. E. F. Petrova, M. I. Lapshina, and L. A. Shvartsman (Central Scientific Research Inst. of Ferrous Metallurgy). Doklady Akad. Nauk S.S.S.R. 121, 1021-4(1958) Aug. 21. (In Russian)

A thermodynamic method is offered for directly determining carbon concentrations in solid solutions. In combination with other data, the method permits the evaluation of carbon solubility in ferrites in equilibrium with cementite at low temperatures and in equilibrium with γ iron at high temperatures. (R.V.J.)

778

THE PRODUCTION OF SUPERFINE FILM GLASS AND ITS USES. I. I. Kitaigorodskii and V. A. Blinov. Doklady Akad. Nauk S.S.S.R. 121, 1060-2(1958) Aug. 21. (In Russian)

Descriptions are given of the production method, technological specifications, and properties of various superfine glass films. (R.V.J.)

779

X-RAY INVESTIGATIONS ON VAPOR DEPOSITED BISMUTH FILMS AT LOW TEMPERATURES. Hans-

Joachim Queisser (Univ. of Göttingen, Ger.). Z. Physik 152, 495-506(1958). (In German)

Strongly disturbed films of bismuth with additions of LiF, RbI, Cu, and Sb were prepared at the temperature of liquid H_2 by vapor condensation. Their structure depends on the production and was investigated during the annealing by x radiography. In the Debye-Scherrer diagrams obtained, details of the resistance behavior of these films were shown. All additions investigated stabilized the unordered state of the bismuth which develops in the condensation and gives hazy interferences in the diffraction patterns. A distinct influence of the addition on the coarse crystals was found. RbI was obtained by Bi additions in a strongly disturbed state. (tr-auth)

780

THE DETERMINATION OF THE ELECTRIC CONDUCTIVITY OF OXIDE COATINGS ON ALUMINUM IN A MOIST ATMOSPHERE. Ye. I. Kmito and A. A. Kmito. Zavodskaya Lab. 24, 303-6(1958). (In Russian)

Three methods for the determination of the electric conductivity of oxide coatings on Al in a moist atmosphere are described. In the first method, which is used in rough estimates, a nickel wire is wound around the Al sample which serves at the cathode. The wire is the anode. The wire is connected to a series of batteries, and the resistance is measured at 7.5 v. The second method, which is used for low moisture contents, is based on a sort of tube ohmmeter with an electron tube. In the third method, which is used for high moisture contents, a radiotransmitter is used. The sounds which are emitted are a function of the resistance. A hysteresis effect noticed with an increase and decrease of moisture was explained by electrode polarization. (J.S.R.)

781

THE DETERMINATION OF THE DIFFUSION VELOCITY OF HYDROGEN IN METALS. R. A. Ryabov and P. V. Gel'd. Zavodskaya Lab. 24, 306-8(1958). (In Russian)

A device used in the determination of the diffusion velocity of hydrogen in metals is described. The sample is placed in the device, which is hermetically sealed except for the hydrogen inlet. The middle of the device is heated and the two ends are cooled with water. The pressure changes are measured. The derivation of the equation used in calculating the diffusion velocity is given. Results obtained on iron alloys and steels are given. (J.S.R.)

782

THE MEASURING OF THE MAGNETIC SUSCEPTIBILITY OF LIQUID METALS. A. A. Vertman and A. M. Samarin. Zavodskaya Lab. 24, 309-10(1958). (In Russian)

The variation of the weight of a metal in a magnetic field is proportional to the magnetic susceptibility with the volume remaining constant. A description is given of a device which measures the magnetic properties of liquid metals by a comparative determination of the tension and susceptibility of standard samples. The results of measurements made on liquid alloys of iron–nickel, nickel–cobalt, and iron–silicon at 1700°C are presented. (J.S.R.)

783

THE DEVELOPMENT OF ULTRASONIC APPARATUS FOR CONTROLLING THE QUALITY OF WELDING JOINTS. A. K. Gurvich. Zavodskaya Lab. 24, 342-6 (1958). (In Russian)

Devices used in the ultrasonic inspection of welds are described. Schematics for various types are presented. (J.S.R.)

784

THE MODERNIZATION OF THE HIGH-TEMPERATURE VACUUM FURNACE TVV-2M. V. G. Avetikov, N. S. Kostyukov, and B. Ye. Kuznetsov. Zavodskaya Lab. 24, 356-8(1958). (In Russian)

A modification of the high-temperature vacuum furnace TVV-2M which consists of the exchange of the tungsten heating elements for graphite and the increase of the dimensions, is described. The durability of the graphite furnaces is three to four times greater than that of the tungsten furnaces. Also five melts a day can be carried out in the graphite furnaces instead of the one a day in the furnace with tungsten heating elements. (J.S.R.)

785

THE APPLICATION OF COAL- AND GRAPHITE HEATING ELEMENTS IN THE TVV-2 FURNACE. Ye. I. Mozzhukhin and V. I. Shulepov. Zavodskaya Lab. 24, 359-60(1958). (In Russian)

The development of carbon and graphite heating elements which can be placed in the TVV-2 furnace in 20 to 25 min is described. The carbon heating elements can be used to temperatures of 1200°C, but the graphite heating elements can be used at higher temperatures. The furnace is used for work in inert atmospheres. (J.S.R.)

786

INHIBITORS OF METAL CORROSION. Iya Nikolayevna Putilova, Stepah Afanas'yevich Balezin, and Valeriy Pavlovich Barannik. Moscow, Goskhimizdat, 1958. 183p. (In Russian)

A manual for engineering and technical personnel engaged in the chemical, metallurgical, and petroleum industries where the problem of metal corrosion arises is presented. The corrosion inhibitors for metals used in water, aqueous acid solutions, and alkaline and salt solutions are described. The corrosion inhibitors for metals used in ordinary atmospheric conditions and in nonaqueous liquid media are also discussed. The theoretical concepts of the mechanism of corrosion inhibition are reviewed. (J.S.R.)

PARTICLE ACCELERATORS AND HIGH-VOLTAGE MACHINES

Refer also to abstracts 987, 1008, 1019, 1020, 1021, 1022, 1030, 1031, 1032, and 1033.

787 AERE-A/R-2661

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

THE DYNAMICAL DESIGN OF BUNCHERS FOR LINEAR ACCELERATORS. T. R. Walsh. Aug. 1958. 20p. $0.63(BIS).

It is shown by a simplified non-relativistic treatment how buncher performance may be found by superimposing the locus of bunched particles upon the accelerator acceptance region in phase space. The efficiency of the bunching and the effect of changes in injection energy are deduced. Design data are included in graphical form. (auth)

788 CERN-58-22

European Organization for Nuclear Research, Geneva.

THE 2.5 MW H. F. AMPLIFIER OF THE CERN LINEAR ACCELERATOR. E. Zaccheroni. Sept. 1958. 27p.

A description of the grounded grid amplifier using tuned coaxial lines designed for meeting H. F. power

requirements of the CERN linear accelerator is given. Performance curves are given for this amplifier terminated in a matched load or short circuited. Guidance is given in choosing a suitable working point to prevent damage in the cavity and cables due to an external mismatch. (auth)

789 MURA-423
Midwestern Universities Research Assn., Madison, Wis.
A STUDY OF THE RF PHASE PLANE NEAR TRANSITION WITH FREQUENCY MODULATION. Margaret Foster and Gareth Guest. Aug. 6, 1958. 24p. Contract AT(11-1)-384. $4.80(ph OTS); $2.70(mf OTS).

The theory given in MURA-106 of rf acceleration near the transition energy is generalized to apply to moving coordinates synchronous with a frequency modulated rf voltage. Formulas are developed for fixed points and separatrices in the rf phase plane, and for frequencies of phase oscillations. Digital computer studies of the acceleration process have been made and resulting rf phase plots are presented. Computed bucket areas are given as functions of the parameters η, Γ introduced in MURA-106. A criterion is formulated for the applicability of the adiabatic approximation in the neighborhood of the transition energy. (auth)

790 UCRL-3734(Rev.)
California. Univ., Berkeley. Radiation Lab.
PEELER EXTRACTION OF A SYNCHROCYCLOTRON BEAM. Rodolfo J. Slobodrian. Aug. 8, 1957. 7p. Contract W-7405-eng-48. $1.80(ph OTS); $1.80(mf OTS).

Peeler extraction is proposed which uses a perturbation that recedes with increasing radial amplitude. The recession is measured angularly, and its direction is opposite to the direction of beam circulation. A successful encounter of the perturbed field is defined as one that results in a radial oscillation amplitude. The recession is a way of adequately phasing the perturbation, in order to exclude encounters when the radial velocity points toward the center of the machine. (J.R.D.)

791
MASS SPECTROMETRY IN GLOW DISCHARGES.
M. Pahl and U. Weimer (Max-Planck-Gesellschaft, Hechingen, Ger.). Z. Naturforsch. 13a, 745-53(1958) Sept. (In German)

The connection of a direction focusing 60° mass spectrometer to the stationary positive low pressure column with the aim of quantitative measurements of ion stream velocities was described. The ions obtained from the plasma result from ambipolar effusion. Ions, which possess strongly different mobilities, do not effuse with equal energy. By means of an opposing field method, such energy differences were determined and measured between $Ne^+ - Ne_2^+$, $Ne^+ - NeH^+$, and $He^+ - He_2^+$. The isotopes of neon had the same energy within the measuring error. A quantitative estimation showed that the volume-recombination process under the chosen conditions was not noticeable in He and Ne. (tr-auth)

PHYSICS AND MATHEMATICS

General

Refer also to abstracts 994 and 995.

792 AECU-3826
Los Alamos Scientific Lab., N. Mex.
RAPID READING OF LARGE BINARY SCALES. Ernest C. Anderson. [1955?]. 9p. Contract [W-7405-eng-36]. $1.80(ph OTS); $1.80(mf OTS).

A chart is presented for use in the rapid conversion of octal to decimal numbers. Tabulated data compare the decimal and octal systems, and decimal and binary numbers up to $19_{10} = 10{,}011_2$. Application of the data in reading scaling circuits is discussed. (C.H.)

793 AECU-3840
[Knolls Atomic Power Lab., Schenectady, N. Y.]
SIMULATION OF SHOCK AND VIBRATION ENVIRONMENTS. [R. M. Mains.] Feb. 1958. 29p. Contract [W-31-109-Eng-52.] (M-6484). $4.80(ph OTS); $2.70 (mf OTS).

The purpose of simulation of shock and vibration environments is to produce in the tested item a process of damage which is related in some useful and known way to the damage which is expected from the service environment. An attempt is made to develop a clear picture of what constitutes realism in environmental simulation. (W.L.H.)

794 AECU-3858
California. Univ., Los Angeles.
ATTENUATION AND DISPERSION OF SOUND BY SOLID PARTICLES SUSPENDED IN A GAS. L. P. Delsasso. June 26, 1957. 43p. Supported in part by Sandia Corp. Contract 51-0796. (M-6339). $6.30(ph OTS); $3.00(mf OTS).

Measurements are presented which have been made on audio frequency sounds propagating through a gaseous medium containing small solid particles in suspension. Two effects were measured; attenuation and dispersion of sound in the dust-filled gas. The measurements were made by sending a short train of sine waves through the dust filled gas and observing the changes produced in the transmitted sine burst. From the changes in arrival time of the short train of waves the velocity shift caused by the suspended dust was determined. Changes in height of the received sine burst provided a measure of the attenuation. The particles were suspended in four different gases, air, argon, oxygen, and helium. The measured attenuation has been compared with existing theory and found to agree within experimental error. The theory takes into account viscous and thermal losses brought about when particles are present. A theory for the corresponding dispersion is presented. This predicts the change in velocity produced by an alteration of the heat capacity and density of the gas when filled with dust particles. (auth)

795 DTMB-1232
David Taylor Model Basin. Applied Mathematics Lab., Carderock, Md.
FRAMEWORKS I AND II: AUTOMATIC PROGRAMMING SYSTEMS FOR UNIVACS I AND II. Arthur Shapiro. Aug. 1958. 58p.

Frameworks I and II are automatic programming systems designed for the UNIVAC, a high-speed electronic digital computer. This report contains a detailed description of the capabilities and limitations of the systems, and full directions on how to use them. (auth)

796 ISC-940
Ames Lab., Ames, Iowa.
IONIZATION YIELDS FOR FISSION FRAGMENTS. Nyle G. Utterback, C. L. Hammer, and G. H. Miller. Aug. 1957. 122p. Contract W-7405-eng-82. $2.75 (OTS).

The ratio of the ionization produced in stopping a fission fragment to the ionization produced in stopping an alpha particle, R, was measured in helium, argon, and a

helium plus 0.25% argon mixture for the most probable light and heavy fragments. Natural uranium was fissioned by fast neutrons from the D,D reaction. The alpha particles were obtained from U^{234} and U^{238}. Measurements were made with a parallel-plate gridded electron-collection single chamber. Saturation characteristics were studied in detail, and small corrections were made for pulse risetime differences and grid-shielding inefficiency. Gas purity and electron loss were checked by making absolute average energy per ion pair measurements for alpha particles. Values of 26.7 ± 0.3 and 41.0 ± 0.4 ev per ion pair were obtained for argon and helium respectively. These values are in good agreement with those obtained in very pure gases by total ion collection by other investigators. (auth)

797 LA-2232

Los Alamos Scientific Lab., N. Mex.

AN IMPLICIT, NUMERICAL METHOD FOR SOLVING THE TWO-DIMENSIONAL HEAT EQUATION. George A. Baker, Jr. and Thomas A. Oliphant. June 1958. 30p. Contract W-7405-eng-36. $4.80(ph OTS); $2.70(mf OTS).

A generalization of the one-dimensional Peaceman and Rachford method is derived. In this generalization simultaneous equations are set up and solved once for all values of the temperature over the entire two-dimensional mesh. This method is extended to treat nonlinear heat flow and it is unconditionally stable, both for linear and nonlinear problems. In the nonlinear case an iterative scheme is employed to solve the simultaneous equations which provides second-order convergence. This method differs from the well-known alternating-direction method in that the alternating-direction method does not solve the complete set of simultaneous equations at each time step, but only a one-dimensional facsimile of them, and its range of applicability is more restricted. (auth)

798 LA-2238

Los Alamos Scientific Lab., N. Mex.

THE GENEVA COUNTER. A LARGE LIQUID SCINTILLATION COUNTER FOR MEN AND MESONS. Ernest C. Anderson, F. Newton Hayes, and Richard D. Hiebert. July 1958. 24p. Contract W-7405-eng-36. $1.00(OTS).

A new and greatly improved liquid scintillation counter, constructed for the Second Conference on Peaceful Uses of Atomic Energy at Geneva, is described. Natural potassium activity of the human body can be measured to a precision of 3 per cent in 100 seconds of counting time, and the sensitivity for extraneous gamma activity is better than 0.001 μc. Hard beta emitters, such as Sr^{90} and Y^{90}, can be measured at 10 per cent of the maximum permissible body burden. Energy resolution is adequate to permit simultaneous measurements in 4 energy channels, e.g., K^{40}, Cs^{137}, I^{131}, and bremsstrahlung. As illustrations of the usefulness of large detectors for the study of cosmic rays and rare nuclear events, results are given of the measurement of the mu meson half-life and decay electron spectrum and of the cosmic ray background spectrum above 1,000 Mev. (auth)

799 MURA-234

Midwestern Universities Research Assn., Madison, Wis.

FORMESH FUMBLEBUMPS (PROGRAM 60). [Period Covered] February–March 1957. J. N. Snyder. 6p. $1.80(ph OTS); $1.80(mf OTS).

This report and the two following ones deal with IBM programs. (J.E.D.)

800 MURA-235

Midwestern Universities Research Assn., Madison, Wis.

FORMESH WITH MUMBLEBUMPS (PROGRAM 61). [Period Covered] February–March 1957. J. N. Snyder. 3p. $1.80(ph OTS); $1.80(mf OTS).

801 MURA-236

Midwestern Universities Research Assn., Madison, Wis.

FORMESH WITH GRUMBLEBUMPS (PROGRAM 62). [Period Covered]: February–March 1957. J. N. Snyder. 5p. $1.80(ph OTS); $1.80(mf OTS).

802 NP-6982

Uppsala Univ.

ANGULAR MOMENTUM WAVE FUNCTIONS CONSTRUCTED BY PROJECTION OPERATORS. Technical Note No. 12. Per-Olov Löwdin. May 10, 1958. 36p. Contract AF61(514)-1200.

The conventional method of constructing wave functions of pure angular momentum for a composite system is based on the idea of coupling the angular momenta of the constituents. Instead of this synthetic method, an analytical approach is here introduced. It is pointed out that an arbitrary trial wave function for the total system in a unique way must be resolvable into orthogonal components of pure angular momentum associated with different quantum numbers. A particular component can be selected by means of certain "projection operators," which annihilate all components except the one desired. Such a projection operator is simply a product of commuting factors, each one of which annihilates a specific eigenfunction to the angular momentum under consideration. Physically this idea is of importance, since one can now start out from a rough model wave function based essentially on qualitative arguments, for instance of the independent-particle type, and then obtain a mathematically and physically much better trial function by selecting the particular component of the original function which has the correct symmetry type desired. The projection operators are studied in some detail both as products and in expanded form. The case of degenerate subspaces of the same angular momentum quantum numbers is discussed, and the problem of constructing an orthogonal subset of functions is solved by a simple elimination procedure; the connection with the conventional seniority idea is briefly discussed. (auth)

803 NYO-2340

Johns Hopkins Univ., Baltimore.

ANNUAL REPORT. L. Madansky and F. Rasetti. July 17, 1958. 40p. Contract AT(30-1)-2028. $6.30 (ph OTS); $3.00(mf OTS).

The purpose of the work on electron polarization has been to improve sufficiently the Møller scattering method so that the polarization of β-rays can be measured with an accuracy of about 8%. A 12-cm, 90° magnetic spectrometer is described which produces an approximately parallel beam of electrons. The spectrometer was calibrated with a 6 mc Cs^{137} source and the resolution was determined to be 7%. A search for positron emission in K^{40} was made with the use of a triple coincidence technique. An upper limit of $(3.6 \pm 1.8) \times 10^{-4}$ positrons per second per gram of natural potassium was set. A corresponding upper limit of 0.57 ± 0.29 was computed for the ratio of the squares of the matrix elements, $M_{\perp}^2/M_{\parallel}^2$, for the K^{40} β^+ and β^- transitions. The K-capture to positron-branching ratios in the decay of Ga^{68} were measured using coincidence scintillation spectrometry. The measured ratios were 1.28 ± 0.12 (to the first excited state) and 0.10 ± 0.02

(to the 0^+ ground state). If the kinetic energies of the positron groups leading to these states are assumed to be 0.81 and 1.88 Mev, respectively, the theoretical branching ratios are 1.42 and 0.09. The ratio of positrons to the ground state and first excited state of Zn^{68} was determined to be $[(1.76 \pm 0.24) \times 10^{-2}]^{-1}$. A search for a possible low-lying 0^+ state in Ga^{68} was undertaken through the decay of Ge^{68} by means of x-ray and x-ray–γ-ray coincidences employing NaI(Tl) crystals and a coincidence circuit. An upper limit on the positron emission by Ge^{68} was set as 0.4% per disintegration by following the growth of Ga^{68} in a freshly separated Ge source. In the investigation of W^{180} alpha decay, the total activity in a 1.650 ± 0.002 g $CaWO_4$ crystal was determined to be 31.8 ± 1.6 counts per hour. If this activity is ascribed to W^{180}, the lifetime obtained is $(1.1 \pm 0.6) \times 10^{13}$ years. (W.D.M.)

804 ORNL-2237
Oak Ridge National Lab., Tenn.
PREPARATION OF THIN TRITIUM–ZIRCONIUM TARGETS. B. J. Massey. Feb. 21, 1957. 10p. Contract W-7405-eng-26. $1.80(ph OTS); $1.80(mf OTS).

The production of neutrons by bombarding tritium with accelerated deuterons is discussed. Targets are made by impregnating a thin layer of zirconium with tritium. The equipment is described, and procedures are outlined. (A.C.)

805 ORNL-2521
Oak Ridge National Lab., Tenn.
MEASUREMENT OF ELECTRON FLUX IN MEDIA BOMBARDED BY X-RAYS (thesis). D. R. Nelson, R. D. Birkhoff, R. H. Ritchie, and H. H. Hubbell, Jr. Oct. 28, 1958. 109p. Contract W-7405-eng-26. $16.80(ph OTS); $5.70(mf OTS).

Submitted to Vanderbilt Univ.

The energy distribution of the electron flux generated by lightly filtered 250 KVCP x-rays has been determined for media consisting of pairs of parallel plates made of copper, aluminum or graphite. The space between the plates was kept at high vacuum and the plate current was recorded as a function of plate voltage. Saturation currents of 0.0063, 0.0011, and 0.00024 esu/cm^{2}r for the three chambers, respectively, were obtained at about 30 volts plate potential. All curves reached saturation at much lower applied voltages than would be expected from the energy distribution suggested by Greening. It was found possible to obtain the energy distributions from the first and second derivatives of the current-voltage curves. All distributions were fitted well with the function

$$\frac{\alpha}{[E-(E_w-1)]^2} \quad \frac{\text{esu}}{\text{cm}^2\text{r volt}}$$

where E is the electron energy and E_w is the sum of the Fermi energy and the photoelectric work function, all in volts. The empirical constants α were found to be 0.11, 0.023, and 0.0021 esu volts/cm^{2}r for the three media, respectively, where the E_w were taken to be 11.5, 15.9, and 4.6 volts. (auth)

806 UCRL-5120-T(Rev.)
California. Univ., Livermore. Radiation Lab.
MONTE CARLO METHODS. Edward L. Kaplan. Sept. 1958. 28p. Contract W-7405-eng-48. $4.80(ph OTS); $2.70(mf OTS).

Revised version of a paper published in the Proceedings of the Fifth Annual High-Speed Computer Conference, 1958, Louisiana State Univ., Baton Rouge.

Basic concepts and techniques of Monte Carlo, such as the generation of random numbers, the construction of samples from a given distribution, and techniques for reducing the variance of the estimates, are discussed. The latter include the expected values method, systematic and stratified sampling, importance sampling, splitting and Russian roulette, conditional Monte Carlo, and correlation and regression. These are discussed with reference to two examples: a system comprising a roulette wheel and three urns, and a simplified neutron shielding problem. For the two-stage sampling in the first example, the inequalities among the variances of ten of the estimates obtained by various methods are investigated. (auth)

807 UCRL-5251
California. Univ., Livermore. Radiation Lab.
MOLECULAR DYNAMICS COMPUTATIONS FOR THE HARD SPHERE SYSTEM. Thomas E. Wainwright and B. J. Alder. June 5, 1958. 23p. Contract W-7405-eng-48. $0.75(OTS).

Fast electronic computers were employed to solve exactly the simultaneous classical equations of motion of several hundred rigid elastic spheres. The equation of state for 32 particles shows a first-order transition with a loop of the van der Waals type at a density corresponding to about 50% expansion from close packing. The dependence of the equation of state and in particular the transition on the number of particles used is discussed. The relatively slow rate of the configurational distribution to reach equilibrium is contrasted with the quite fast establishment of the Maxwellian velocity distribution. The approach of the Boltzmann H-function to equilibrium is monotonic even at high density. The equilibrium collision rate can be accurately evaluated at all densities by means of the Enskog theory, while this theory gives good results for the self-diffusion coefficient only up to the transition point. Above that density the Enskog theory correctly predicts the initial decay of the fractional relaxation but fails to take into account the non-Markoffian character in the further time evolution of the relaxation. (auth)

808 UCRL-5310
California. Univ., Livermore. Radiation Lab.
ON THE PICONE TREATMENT OF BOUNDARY-VALUE PROBLEMS FOR PARTIAL DIFFERENTIAL EQUATIONS. Arnold N. Lowan. Aug. 1958. 38p. Contract W-7405-eng-48. $1.00(OTS).

The report deals with an elegant method for the treatment of boundary-value problems in mathematical physics for arbitrary domains with either regular or mixed boundary conditions, involving the superposition of an infinite (or finite) number of linearly independent functions not satisfying the given differential equation. (auth)

809 UCRL-8387
California. Univ., Berkeley. Radiation Lab.
I. A METHOD FOR DETERMINING RADIATIVE LIFETIMES OF HIGH-TEMPERATURE MOLECULES. II. THE PROBABILITY OF SPONTANEOUS NUCLEAR REACTION IN MOLECULAR HYDROGEN (thesis). Richard G. Brewer. July 21, 1958. 73p. Contract W-7405-eng-48. $2.00(OTS).

Part I. An apparatus for determining the radiative lifetimes of gaseous molecules in excited electronic states is described. Lifetimes can be measured in the range 10^{-5} to 10^{-9} sec to an accuracy of 3%. The absolute sensitivity of the apparatus was found in terms of the minimum brightness temperature of a light source that would be needed to determine the lifetime of the

excited state of one of the sodium D lines. This value was 2200°K and corresponded to a light flux of 5×10^5 photons/sec striking the photomultiplier. The lifetime of the $^3\Pi_u$ ($v' = 26$) state of molecular iodine has been found to be 4×10^{-7} sec at 21°C in the saturated vapor. Measurements at 0°C indicate that the fluorescence lifetime is shorter, and therefore 4×10^{-7} sec is to be taken as an upper limit. An important application of lifetime data to the determination of heats of formation in high-temperature molecules is cited. By this technique it should be possible to determine heats of formation with an accuracy of 1%, in contrast with present techniques, which are usually in error by more than 10%. Part II. The probability for spontaneous nuclear reaction in molecular hydrogen was calculated by the use of WKB wave functions. The complete shape of the molecular barrier was derived from spectroscopic data for the hydrogen molecule and from a perturbation calculation of the helium atom. Use of this potential function showed that the probability of penetrating the molecular barrier (for a ground-state molecule) is greater by a factor of about 10^{15} than of penetrating a Coulomb barrier at the same internuclear distance. The half lives for nuclear reaction in the isotopic molecules H^1H^1, H^1H^2, and H^2H^2 are 5×10^{56}, 5×10^{46}, and 1×10^{54} years. (auth)

810 WAPD-201

Westinghouse Electric Corp. Bettis Plant, Pittsburgh.
THERMAL STRESSES IN BODIES OF REVOLUTION. J. P. deVries and R. A. Oerth. July 1958. 33p. Contract AT-11-1-GEN-14. $1.00(OTS).

A method is presented for solving, by relaxation techniques, the problem of thermal stresses in bodies of revolution, subjected to a non-uniform but axially symmetric temperature distribution. Thermal stress problems can be solved by replacing the temperature distribution with certain body forces and surface tensions, and it is shown that the stresses can be expressed in terms of two stress functions which satisfy differential equations of the types of Laplace and Poisson. The stress functions are similar to those formulated by Southwell for the case of zero body forces and with the express purpose of solution by relaxation methods. It is shown that the introduction of body forces does not cause any additional difficulties in Southwell's treatment of bodies with closed cavities. The application of the method is illustrated by the calculation of thermal stresses in a nuclear reactor component, an axially symmetric body subjected to a known temperature distribution. The relaxation technique is discussed in some detail with respect to hand calculations as well as application of an IBM-704 digital computer. In a second example, thermal stresses in a solid sphere subject to a sudden change of temperature at its surface, computed stresses are shown to agree with analytically known values. (auth)

811 YAEC-86

Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh.
JOFIT—A LEAST SQUARES BESSEL J_0 FITTING PROGRAM FOR THE IBM-704 COMPUTER. Jacek Jedruch. July 23, 1958. 39p. For Yankee Atomic Electric Co. Contract AT(30-3)-222, Subcontract No. 1. $6.30(ph OTS); $3.00(mf OTS).

The JOFIT code fits, by a least squares technique, the curve $y = A\,J_0[B(x-C)]$ from 4 to 500 points of observed data, computing the parameters A, B, C and the standard deviation of the final values of A, B, C, i.e., S_A, S_B, S_C. It is also possible to investigate the error in a region about the final values of A, B, C by computing the sums of the squares of the residuals at a series of points in this neighborhood. Typical computing and editing time for a 50 point problem is 2 minutes. Any size IBM-704 computer is adequate, and drums and tapes are not used. (auth)

812 AEC-tr-3346

COMPUTATION OF THE AMOUNT OF INFORMATION ON THE RANDOM FUNCTION CONTAINED IN ANOTHER SUCH FUNCTION. I. M. Hel'fand (Hellfand) and A. M. Yaglom (Yalot). Translated for Oak Ridge National Lab. from Uspekhi Mat. Nauk 12, No. 1, 1-51 (1957). 73p.

813 AEC-tr-3386

THE COANDA EFFECT. Albert Metral and Frédéric Zerner. Translated for Oak Ridge Gaseous Diffusion Plant from Publ. sci. et tech. ministère air(France), No. 218, (1948). 98p.

The phenomenon is explained and its applications to silencers, automobile motors, propeller-decompressors, and pumps are discussed. The theory of fluid flow across a Coanda tuyere and its experimental control is discussed, along with the utilization of the Coanda slit for the control of the boundary layer on the extrados of a hyper-supporting blade. (W.D.M.)

814 AEC-tr-3414

THE DETERMINATION OF THE EFFECTIVE MASSES IN InSb AND InAs FROM THE MEASURINGS OF THE DIFFERENTIAL THERMOPOTENTIAL. (Bestimmung der effektiven Massen in InSb und InAs aus Messungen der differentiellen Thermospannung). H. Weiss. Translated for Ames Lab. from Z. Naturforsch. 11a, 131-8(1956). 14p.

The differential thermopotential was measured on 3P- and 5N-conductive preparations from InAs and on 2P-samples from InSb up to 800°K. From these data the electron effective masses in InAs between 500 and 800°K are calculated. (A.C.)

815 NP-tr-158

ROCKET MEASUREMENTS OF THE ELECTRON CONCENTRATION IN THE IONOSPHERE USING AN ULTRASHORTWAVE DISPERSION INTERFEROMETER. K. L. Gringauz. Translated by Morris D. Friedman (Lincoln Lab., MIT) from Doklady Akad. Nauk S.S.S.R. 120, 1234-7(1958). 8p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 12, as abstract No. 15673.

816 NP-tr-159

OPTIMUM AND ALMOST OPTIMUM BINARY CODES. K. A. Meshkovskii. Translated by Morris D. Friedman (Lincoln Lab., MIT) from Elektrosvyaz 12, No. 5, 5-15 (1958). 17p.

A method of constructing optimum and approximately optimum binary codes by using certain results of the geometry of n-dimensional space is analyzed. A number of theorems is given which refer to binary coding theory. Broad groups of the above mentioned codes are presented. (auth)

817 NP-tr-160

PHONON INTERACTION OF ELECTRONS IN POLAR CRYSTALS. A. V. Tulub. Translated by Morris D. Friedman (Lincoln Lab., MIT) from Zhur. Eksptl'. i Teoret. Fiz. 34, 1641-2(1958). 4p.

The phonon interaction potential of electrons is derived taking into account their relative momentum in the intermediate binding approximation. (W.D.M.)

818 NP-tr-173

SOME DATA ON SUPER-CRITICAL FLOW IN TURBINE PROFILE CASCADES. L. M. Zysona-Molozhen and I. G. Shapiro. Translated from Teploenergetika 3, 34-7 (1955). 4p.

Some data are presented on an interferometric method of detecting super-critical flow in several turbine profile cascades, and several ways of avoiding choking shock waves in the channels between the profiles are demonstrated. A quantitative estimate is given of the effect of two consecutively positioned cascades on the general pattern of flow. (auth)

819 TT-757

ENRICHMENT OF ISOTOPIC MOLECULES IN THE D. C.-GLOW DISCHARGE. II. THE MULTIPLICATION PROCESS. ENRICHMENT OF HEAVY HYDROGEN. (Anreicherung isotoper Molekule in der Gleichstrom-Glimmentladung. II. Der Vervielfachungsprozess. Anreicherung von schwerem Wasserstoff). H. D. Beckey, W. E. Groth, and K. H. Welge. Translated by D. A. Sinclair (National Research Council of Canada) from Z. Naturforsch. 8a, 556-62(1953). 16p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 8, as abstract No. 1145.

820 TT-758

ENRICHMENT OF ISOTOPIC MOLECULES IN THE D. C.-GLOW DISCHARGE. III. THE PRIMARY EFFECT. DETERMINATION OF RELATIVE ION FREQUENCIES IN THE DISCHARGE PLASMA BY MASS SPECTROMETRY. (Anreicherung isotoper Molekülе in der Gleichstrom-Glimmentladung. III. Der Primĕreffekt. Massenspektrometrische Bestimmung der relativen Ionenhaüfigkeiten im Entladungsplasma). H. D. Beckey and H. Drseskamp. Translated by D. A. Sinclair (National Research Council of Canada) from Z. Naturforsch. 9a, 735-40(1954). 15p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 8, as abstract No. 7067.

821 TT-759

ENRICHMENT OF ISOTOPIC MOLECULES IN THE D. C.-GLOW DISCHARGE. IV. THE PRIMARY EFFECT. DETERMINATION OF THE ATOMIC CONCENTRATION IN HYDROGEN AND DEUTERIUM DISCHARGES. H. D. Beckey and P. Warneck. Translated by D. A. Sinclair (National Research Council of Canada) from Z. Naturforsch. 10a, 63-7(1955). 14p.

The atomic concentrations in d-c glow discharges in hydrogen and deuterium were studied with the aid of the cleavage method depending on the current and the pressure. Under similar discharge conditions the relative difference of atomic concentration ([D]−[H])/[H] reaches a maximum of 19%. The dependence of the atomic concentration on the pressure was calculated theoretically and from this, by comparison with the experimental results, the mechanism of molecular dissociation was determined. (auth)

822 XDC-58-10-9

FUNCTIONALLY INVARIANT SOLUTIONS OF EQUATIONS OF THE SECOND ORDER IN TWO INDEPENDENT VARIABLES. N. P. Erugin. Translated by J. F. Heyda (General Electric Co., Cincinnati) from Uchenye Zapiski Leningrad. Gosudarst. Univ. Ser. Mat. Nauk. No. 16, 142-66(1949). 29p.

Useful techniques for solving linear, second-order hyperbolic partial differential equations in two independent variables are discussed. Detailed consideration is given to solving characteristic boundary value problems and Cauchy problems for the case of equations with constant coefficients. (auth)

823

SCATTERING POWER OF ATOMS FOR X AND ELECTRON RADIATION ACCORDING TO THE STATISTICAL THEORY OF ATOMS. T. Tietz (Univ. of Lodz, Poland). Ann. Physik 2, 41-5(1958). (In German)

Equations were derived for the intensity of the incoherent scattering of x and electron radiation by a single neutral Thomas-Fermi atom, and the results were described in a tabular form. The values obtained agree with the results of previous numerical calculations. (tr-auth)

824

INTERPRETATION OF THE H_α SPECTRUM OF THE CHROMOSPHERE. Raymond Michard. Compt. rend. 247, 990-2(1958) Oct. 6. (In French)

The interpretation of the profiles of H_α emission, arising from isolated spicules or from the "mean" chromosphere, supplies different information on the spicules and the interspicular medium. The spicules occupy approximately 6% of the chromosphere at the 1000 to 3000 km levels, a proportion which decreases sharply to 4000 km. (tr-auth)

825

TEMPERATURE AND SPECIFIC HEAT OF PLEXIGLAS COMPRESSED BY A SHOCK WAVE. Ya. B. Zeldovich, S. B. Kormer, M. V. Sinitsyn, and A. I. Kuryapin. Doklady Akad. Nauk S.S.S.R. 122, 48-50(1958) Sept. 1. (In Russian)

The shock wave front was studied through a layer of non-compressed transparent substance. The blue (λ = 4020 A) and red (λ = 6000 A) spectral lines were recorded with a fast photochronograph. The temperature of the polymethylmethacrylate $(C_2H_8O_2)_n$ with the original density 1.18 g/cm^2 was determined at a shock velocity of 16.5 km/sec. In the compressed state the density was equal to 3.15 g/cm^3 at a pressure of 2×10^{12} d/cm. The luminosity temperature measured according to the radiation intensity in the red area was 8,300 ± 500°K, and the temperature determined in relation to the intensities of red and blue spectral areas was 11,000 ± 1,000°K. Considering the original plexiglas energy as zero, the energy of compressed plexiglas is $E = \frac{1}{2} P(V_0 - V) = 0.53 \times 10^{12}$ erg/g. Assuming the atoms are in the ideal gas state at 8300°K and density 3.15 g/cm^3, their compression would be $\rho NkT = 0.33 \times 10^{12}$ d/cm^3 and the thermal energy $\frac{3}{2} NkT = 0.16 \times 10^{12}$ erg/g (N is the number of atoms per g). The total thermal and chemical energy of compressed plexiglas at 8,300°K equals 0.45×10^{12} erg/g and is 3.5 times higher than the energy calculated for the specific heat in normal conditions at room temperature, 0.365 cal = 1.53×10^7 erg/g. (R.V.J.)

826

ON RIEMANNIAN WAVES IN MAGNETIC HYDRODYNAMICS. A. G. Kulikovskii (Lomonosov Moscow State Univ.). Doklady Akad. Nauk S.S.S.R. 121, 987-90(1958) Aug. 21. (In Russian)

New mechanical effects, appearing with Riemann's waves, in magnetic hydrodynamics with arbitrary field distribution are investigated in relation to the wave front plane. (R.V.J.)

827

THE MOLECULAR SPECTRUM OF HYDROGEN AND ITS ISOTOPES. G. H. Dieke (Johns Hopkins Univ., Baltimore). J. Mol. Spectroscopy 2, 494-517(1958) Oct.

The spectra of all six known isotopic species of

molecular hydrogen, H_2, DH, D_2, TH, TD, and T_2 were obtained with high dispersion under several excitation conditions. This has led to a complete wavelength table of these spectra containing about 100,000 different lines. The principal band systems were found in all six spectra and a comparison of the isotopes has resulted in the clarification of many previously doubtful points. A complete table of all known H_2-levels is included. (auth)

828

POLARIZATION OF ELASTICALLY SCATTERED GAMMA-RAYS. I. Lovas (Central Research Inst. for Physics, Budapest). Nuclear Phys. 8, 155-6(1958) Sept.

A method is suggested for obtaining definite information about Delbrück resonance scattering. There is a difference between the angular dependence of the polarization of the Delbrück scattering and that of Thomson and Rayleigh (N. Cindro and K. Ilakovac, Nuclear Physics 5, 647(1958)). Amplitude formulas are given and differential cross sections are calculated. It is shown that the measurement of the polarization of an elastically scattered beam by a detector which is sensitive to linear polarization may lead to a definite proof of the existence of Delbrück scattering. (A.C.)

829

THE FORM OF THE β-SPECTRA OF Na^{22}, Na^{24}, AND P^{32}. H. Daniel (Max-Planck-Inst., Heidelberg). Nuclear Phys. 8, 191-8(1958) Sept. (2).

The β-ray spectra of Na^{22}, Na^{24}, and P^{32} were investigated with an iron-free lens spectrometer. The Na^{22} spectrum is found to follow the allowed distribution between 0.16 and 0.47 Mev. The P^{32} spectrum shows a large deviation from the allowed shape. The deviation is proportional to the electron energy and amounts to $(-4.1 \pm 1.3) \times 10^{-2}/mc^2$. No clear cut result was obtained for Na^{24}, but probably there is a small deviation from the allowed shape. (auth)

830

A CALORIMETER FOR THE TEMPERATURE REGION 1-20°K. THE SPECIFIC HEAT OF SOME GRAPHITE SPECIMENS. W. DeSorbo and G. E. Nichols (General Electric Research Lab., Schenectady, N. Y.). Phys. and Chem. Solids 6, 352-66(1958) Sept.

A high-precision isothermal calorimeter for specific-heat measurements in the temperature range 1 to 20°K is described. The calorimeter container and/or specimen can be cooled down to the lowest temperatures without the need of exchange gas, often a source of difficulty in precision measurements made on such materials as graphite. A detailed discussion is presented on the resistance-temperature data and their analysis concerning the use of commercially available carbon resistors as secondary thermometers in both the liquid-helium and liquid-hydrogen temperature regions. A method is demonstrated for evolving a "working" temperature scale in the region 4.2 to 9.5°K, using carbon resistors. Data on three graphite specimens, obtained in the temperature range 1.3 to 20°K, are reported. These samples, consisting of different crystallite sizes and "degree of faulting," exhibit pronounced variations in their respective specific heats. The data for a natural graphite specimen can be expressed as a sum of two terms, aT^3 and γT. The coefficient of the linear term (electronic specific heat) is $\sim 0.6 \times 10^{-5}$ cal/g atom deg^2. Specific-heat measurements are also reported in the liquid-helium region for a boronated graphite sample. (auth)

831

PARAMAGNETIC-RESONANCE SPECTRUM OF GADOLINIUM IN SINGLE CRYSTALS OF THORIUM OXIDE. W. Low and D. Shaltiel (Hebrew Univ., Jerusalem and Israel Inst. of Tech., Haifa, Israel). Phys. and Chem. Solids 6, 315-23(1958) Sept.

The paramagnetic-resonance spectrum of single crystals of ThO_2 containing less than 0.01 mole % of Gd^{3+} has been analyzed at 290 and 90°K at 3 cm wavelength. The positions and intensities of the lines are explained by a crystalline field of cubic symmetry. The ground state is split with an over-all separation $8c-2d = 0.1755 \pm 0.0003$ cm^{-1}, $c = 219.9 \pm 0.3 \times 10^{-4}$ cm^{-1}, $d = 1.0 \pm 0.3 \times 10^{-4}$ cm^{-1}, $g = 1.9913 \pm 0.0005$ at 290°K; and $8c-2d = 0.1796 \pm 0.0008$ cm^{-1}, $c = 225.0 \pm 0.8 \times 10^{-4}$ cm^{-1}, $d = 1.7 \pm 0.8 \times 10^{-4}$ cm^{-1}, $g = 1.991 \pm 0.001$ at T = 90°K. Transitions corresponding to $\Delta M = \pm 3$, $\Delta M = \pm 4$, $\Delta M = \pm 5$ were observed. The narrow line width of less than 1 G permits the detection of the hyperfine structure of the two isotopes 155 and 157. The ratio of the magnetic moments is $\mu_1^{155}/\mu_1^{157} = 0.744 \pm 0.007$ and the spectra are consistent with nuclear spins of $\frac{3}{2}$ for both isotopes. It is suggested that there are oxygen vacancies distributed at random throughout the crystal. (auth)

832

THE LOW-TEMPERATURE SPECIFIC HEAT OF GRAPHITE. J. C. Bowman and J. A. Krumhansl (Union Carbide Corp., Cleveland). Phys. and Chem. Solids 6, 367-79(1958) Sept.

In a companion paper (see preceding abstract) a calorimeter especially suitable for the accurate low-temperature specific-heat measurement of polycrystalline materials was described and its use with graphite samples was reported. Using this apparatus, it was noted that there were significant differences in the heat capacity of various types of graphite. The present paper deals with further experiments and theoretical analysis undertaken to identify the cause of these differences. The experimental program was based on a set of graphite samples prepared in such a way as to control electronic and structural factors in nearly independent fashion. The results show that the major difference in heat capacity between various graphites, in the liquid-helium temperature range, is not due to electronic factors. The theoretical analysis leads to the conclusions that, first, both electronic and lattice-vibration theories are in good agreement with experiment, and second, in lampblack graphite the random stacking of layer planes can account both qualitatively and quantitatively for the specfic heat in excess of that of natural graphite. Estimated values of the elastic constants of graphite are presented. (auth)

833

PARTICLE-SIZE EFFECT OF THE SPECIFIC HEAT OF GRAPHITE AT LOW TEMPERATURES. K. Komatsu (Univ. of Osaka Prefecture, Mozu-Higashi, Sakai, Japan). Phys. and Chem. Solids 6, 380-5(1958) Sept.

The particle-size effect of the specific heat of graphite at low temperatures observed by DeSorbo and Nichols is explained on the basis of the theory of Komatsu and Nagamiya. Smaller values of the elastic constants c_{44} and c_{33} are assumed for specimens of smaller sizes. With suitable choices of their values, particularly that of c_{44}, it is shown that the calculated specific-heat curves fit satisfactorily with the observed points. It is concluded that significant differences in the specific heat of various graphite specimens at low temperatures are due mostly to different values of c_{44}. (auth)

834
THE MECHANISM OF ENERGY SPREADING IN CADMIUM SULFIDE CRYSTALS. I. Broser and R. Broser-Warminsky (Max-Planck-Gesellschaft, Berlin-Dahlem). Phys. and Chem. Solids 6, 386-400(1958) Sept.

In photoconducting phosphors the spreading of the energy of excitation from the point of absorption to unirradiated regions of the crystal plays an important part. It had been established earlier for cadmium sulfide single crystals that besides the energy transfer over only short distances by means of charged particles, still another process must take place in which photoconduction is spread over relatively large distances. It is shown that all the results obtained heretofore can be explained if it is assumed that the process with a large diffusion length results from the scattering and reabsorption of the incident light or the luminescent radiation generated in the crystal. The repeatedly introduced hypothesis of energy conduction by excitons is not supported by a more precise analysis of the experimental results. The transfer of energy by means of charged particles may be investigated using high-purity crystals which do not absorb their own luminescent radiation, i.e., in which the process of light scattering is nearly eliminated. From the non-linear voltage dependence of the photo-current of a crystal excited at one side only, it is concluded that holes are the determining factor for this energy conduction. The diffusion length is about 1μ and has a positive temperature coefficient. (auth)

835
SUPRATHERMAL PARTICLES. E. N. Parker and D. A. Tidman (Univ. of Chicago). Phys. Rev. 111, 1206-11(1958) Sept. 1.

The production of suprathermal particles in agitated plasmas bearing magnetic fields is discussed. This is done by setting up a Fokker-Planck equation to describe the phenomenon. The role of such particles in astrophysics and in the problem of the production of thermonuclear power is considered. (auth)

836
QUANTUM-MECHANICAL KINETIC ENERGY TRANSFORMATION. A. J. Freeman (Massachusetts Inst. of Tech., Cambridge and Ordnance Materials Research Office, Watertown, Mass.) and P. O. Löwdin (Univ. of Uppsala). Phys. Rev. 111, 1212-13(1958) Sept. 1.

It is shown by a transformation of the usual expression for the kinetic energy matrix elements a simpler formula results which yields, for numerical wave functions, higher numerical accuracy for the kinetic energy than has previously been obtained. The derivation of the transformation and the numerical results of several applications are presented. (auth)

837
PREDICTED RADIATION OF PLASMA OSCILLATIONS IN METAL FILMS. Richard A. Ferrell (Univ. of Maryland, College Park). Phys. Rev. 111, 1214-22 (1958) Sept. 1.

Because of their highly collective nature it is predicted that plasma oscillations in a thin metal film should, under the proper circumstances, give off ultraviolet radiation. The plasma oscillations can be excited by fast electrons, incident normal to the film and inelastically scattered by it. Surface effects are essential, and of the special types of oscillations which can occur in a plane parallel slab of electron gas, only that involving motion normal to the slab can radiate. The yield is computed to be one photon for every one thousand electrons incident at 10 kev. The radiation is at the plasma frequency, ω_p, or at 2100 A for a sodium film. Its identification should be facilitated by the characteristic $\cos\theta$ dependence of the intensity, where θ is the angle between the foil normal and the direction of emission of the photon. Straightforward computation yields a radiative mean life of $\omega_p^{-1}(\lambda_p/\pi\tau) \times (\cos\theta/\sin^2\theta)$, which is generally shorter than that due to interband damping, except at small angles. λ_p is the photon wavelength and τ the film thickness. From the competition of the two decay modes it should be possible to determine the intrinsic damping rate, and hence the product of the optical constants nk. The radiative lifetime is so short as to produce appreciable line-broadening, and thereby provide an independent check on the experiment. In the appendix the inelastic electron scattering coefficient is derived for the excitation in a thin film of the radiative-type plasma oscillations. (auth)

838
HALL EFFECT IN Lu, Yb, Tm, AND Sm. G. S. Anderson, S. Legvold, and F. H. Spedding (Iowa State College, Ames). Phys. Rev. 111, 1257-8(1958) Sept. 1.

The Hall effect in Lu, Yb, Tm, and Sm was studied as a function of temperature for the temperature range 40 to 320°K in a magnetic field of 5500 oe. The Hall coefficient for Yb is positive, while the Hall coefficients for Lu and Tm are negative. Sm has a negative Hall effect at room temperature, but at lower temperatures the sign apparently changes. (auth)

839
THEORY OF THE FERROELECTRIC EFFECT IN ROCHELLE SALT. Toshio Mitsui (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. 111, 1259-67 (1958) Sept. 1.

Mueller's phenomenological theory of Rochelle salt, $NaKC_4H_4O_8 \cdot 4H_2O$, is generalized, and the properties of the clamped crystal described. A local field theory of the clamped crystal was developed on the basis of the structure analysis of Frazer, Danner, and Pepinsky. Special care was taken to avoid any arbitrary assumptions in the theory. A chart is given which shows conditions for the occurrence of ferroelectricity. It is shown that the difficulties of Mason and Devonshire's theories are the results of too simplified assumptions on the coefficients of the local field. Various quantities which appear in the theory were calculated using the fact that the reciprocal susceptibility of the clamped crystal has a single zero value. The calculated coefficients which appear in the Taylor series expansion of Helmholtz free energy agree well with those predicted by the phenomenological theory. An explanation is given for the properties of the mixed crystal series, $Na[K_\alpha(NH_4)_{1-\alpha}]C_4H_4O_8 \cdot 4H_2O$. (auth)

840
ELASTIC CONSTANTS OF CALCIUM FLUORIDE. R. Srinivasan (Indian Inst. of Science, Bangalore). Proc. Phys. Soc. (London) 72, 566-75(1958) Oct.

Employing Born's theory of crystal lattices, the elastic constants of fluorspar were evaluated theoretically. Besides the coulomb forces, repulsive forces between nearest neighbor calcium and fluorine atoms and fluorine–fluorine atoms were assumed and the constants of the repulsive energy were evaluated from the equilibrium condition, the experimentally determined compressibility and the principal Raman frequency of fluorspar. The experimental values of c_{11}, c_{12}, and c_{44} are in fair agreement with the theoretically calculated values. Born's theory gives the sign of $c_{12}-c_{44}$ for fluorspar correctly but the theoretically calculated

value of $c_{12}-c_{44}$ is only about half the experimentally observed value. (auth)

841

THE AMPLIFICATION OF A MAGNETIC FIELD BY A HIGH CURRENT DISCHARGE. R. J. Bickerton (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Proc. Phys. Soc. (London) 72, 618-24 (1958) Oct.

A discharge in a longitudinal magnetic field in which the plasma pressure is balanced by electrodynamic forces is considered. It is shown that the resulting current flow is helical about the axis of the discharge. The direction of the helix is such that the initial longitudinal field is amplified inside the discharge channel. Some experimental evidence supporting the theory is presented. (auth)

842

ULTRA-HIGH-FREQUENCY GAS BREAKDOWN BETWEEN ROGOWSKI ELECTRODES. W. A. Prowse and J. L. Clark (Univ. of Durham, Eng.). Proc. Phys. Soc. (London) 72, 625-34(1958) Oct.

Electrons may be removed from the gas between a pair of plane parallel electrodes by being swept out by the field, by recombination, by attachment, or by diffusion. At high enough frequencies diffusion is the most likely mechanism. This can be tested quantitatively by plotting the relation between $E\Lambda$ and $p\Lambda$ (E = electric field required to produce breakdown, p = gas pressure, Λ = 'diffusion length' for the gap). It can also be tested qualitatively by observing the decrease of E with increasing gap width d. The electrodes must be properly profiled to avoid breakdown beginning at the edges. The necessary observations of breakdown voltage, electrode spacing, electrode size, and gas pressure are made for air, hydrogen, nitrogen, and neon, at 9.5 Mc/s. The ($E\Lambda$,$p\Lambda$) plot gives a single line for ultra-high-frequency breakdown, and E decreases with increasing d in accordance with diffusion theory. Values of the ionizing efficiency η are calculated. (auth)

843

PRODUCTION AND DETECTION OF THE H^- CONTINUUM IN SHOCK WAVE TUBES. Otfried Weber (Univ. of Kiel). Z. Physik 152, 281-93(1958). (In German)

In shock wave tubes the temperature evolved in the collision of hydrogen against hydrogen is not sufficient to produce enough free electrons for the reaction $H + e = H^- + h\nu$. A mixture of krypton and hydrogen in the low pressure part of the tube gives sufficiently high temperatures. The krypton acts as an additional electron producer with respect to the best value of the partial function. The continuum observed agrees with the expected value with respect to the absolute intensity as well the spectral intensity distribution in the range between 5700 and 4400 A. An increase of the intensity by about 25% might indicate the location of the Balmer transition. The small amplitude of the Balmer transition found produces a further argument for the existence of the H^- continuum. Also the experimentally found dependence of the total continuum on the temperature corresponded quantitatively with the expected results. (tr-auth)

844

AN EXPANSION OF THE TOWNSEND APPROXIMATION FORMULA FOR IONIZATION IN THE HOMOGENEOUS ELECTRIC FIELD. H. Neu (Technische Hochschule, Darmstadt, Germany). Z. Physik 152, 294-305(1958). (In German)

The Townsend approximation formula $\alpha/p = Ae^{-Bp/X}$ for the ionization of a gas by electrons under the influence of the electric field intensity X is useful only in a narrow field intensity range. By introduction of a supplementary parameter the approximation was improved and the validity range was expanded to small field intensities. The possibilities for an expansion to larger field intensities were investigated. A semi-empirical approximation formula was given for the spatial average value of the ionization by an electron which has passed through a potential difference U in a homogeneous field. This formula contains, in addition to the case of the stationary velocity distribution of the electrons and spatial constant ionization, stronger fields with non-stationary velocity distribution and position dependent ionization. (tr-auth)

845

THE CIRCULAR POLARIZATION OF THE INTERNAL BREMSSTRAHLUNG IN THE K-CAPTURE OF Ar^{37}. G. Hartwig and H. Schopper (Univ. of Mainz). Z. Physik 152, 314-18(1958). (In German)

The circular polarization of the internal bremsstrahlung was measured for various photon energies by scattering on magnetized iron. In the spectral range investigated, complete polarization was found within the measuring error. An average value of $P_c = +1.03 \pm 0.04$ was obtained. This shows that the maximum parity violation occurs also in K-capture. (tr-auth)

846

CIRCULAR POLARIZATION OF GAMMA RAYS FOLLOWING SOME FIRST-FORBIDDEN BETA TRANSITIONS. F. Boehm (California Inst. of Tech., Pasadena). Z. Physik 152, 384-6(1958).

The forbidden beta transitions of As^{76}, Rb^{86}, and Au^{198} were investigated by the circular polarization correlation method. From the anisotropy of the circular polarization found, values for a combination of forbidden matrix elements were derived under the assumption of maximum interference between the Fermi and Gamow-Teller parts of the reciprocal effects. (tr-auth)

847

THE INDIUM DEUTERIDE AND HYDRIDE BANDS AND THEIR HYPERFINE STRUCTURE. Hinrek Neuhaus (Univ. of Stockholm). Z. Physik 152, 402-16(1958). (In German)

Thirteen InD bands, distributed among three band systems, were observed in the visible region and were analyzed. The bands, especially those of the $^1\Pi - X^1\Sigma^+$ transition, were both perturbed (presence of surplus lines) and also predissociated (diffusness of many lines). $^3\Pi_2$ was assumed to be the perturbed state in the $^1\Pi$ case. The nuclear magnetic hyperfine structure (Hfs), which was observed only in the first line of the (0-0), $^3\Pi_1 - X^1\Sigma^+$ band, is very similar to the Hfs of the corresponding InH band. The coupling constant A = 0.028 cm^{-1} was calculated graphically. A detailed discussion of the results found will appear in a later investigation. (tr-auth)

848

INTRODUCTION TO NUCLEAR ENGINEERING. Second Edition. Richard Stephenson. New York, McGraw-Hill Book Company, Inc., 1958. 499p.

In selecting material for inclusion in the book, the author assumed that the reader was familiar with the basic principles of engineering and the sciences. The chief emphasis is on topics which differ from standard engineering practice, particularly those topics unique to the field of nuclear engineering. Because of the increasing importance of nuclear power reactors, the basic engineering problems associated with the analysis

of reactor cores are covered. A chapter has been added in the second edition on thermonuclear reactions. Several chapters have been expanded considerably. (W.D.M.)

849

TABLES FOR X-RAY STRUCTURE ANALYSIS. VOLUME VIII. Konrad Sagel. Berlin, Springer-Verlag, 1958. 214p. $6.64. (In German)

Tables are given for determination of crystal interferences, determination of line intensities, and analysis of scattering background. Physical and mathematical tables are also included. Each series of tables is preceded by explanations on the use of the tables. (J.S.R.)

850

NUCLEAR TECHNICS; PHYSICS, TECHNOLOGY, REACTORS. PART 7. Wolfgang Riezler and Wilhelm Walcher, eds. Stuttgart, B. G. Teubner Verlagsgesellschaft, 1958. pp. 961-1002. (In German)

In the final section of the book the appendices, author index, and subject index are presented. (J.S.R.)

Elementary Particles

851 AFOSR-TN-58-858

Purdue Univ., Lafayette, Ind.

UNIVERSAL WEAK BOSON AND FERMION INTERACTION. Masao Sugawara. [1958]. 20p. Contract AF18(600)-1579. (AD-203664).

A modified interpretation of an idea of divergenceless currents, due to Feynman and Gell-Mann, is investigated in detail. Pairs of Bosons (pions and K-mesons) are assumed to exist, besides Fermion pairs, among members exerting a universal weak interaction. A K^0-meson-charged pion pair is proposed as well as a pion-pair and pairs of leptons, nucleons, and some hyperons. A strong evidence for this pion-K^0-meson-pair is its surprising fit to short-lived decay of K^0-mesons. An essential presumption is that π-μ decay is consistent with the present scheme though π-e decay is left untouched. If a global symmetry of pion coupling to hyperons is presumed, and K^0-meson interaction is simply assumed as comparatively weaker, the scheme seems consistent with all known data on decays of strange particles. A complete scheme of a universal weak interaction is not obtained uniquely, since there exist no particular necessity nor objection to some pairs of particles, from available theoretical and experimental information. (auth)

852 AFOSR-TN-58-878

Uppsala Univ. Inst. of Physics.

ANTIPROTON INTERACTIONS. Technical Note No. 1. G. A. Ekspong and B. E. Ronne. [1958]. 10p. Contract AF61(052)-13, phase A. (AD-203910).

Data on 200 antiprotons with a total path length of 19.1 m are reported. The antiprotons were observed in G-5 emulsion exposed to the enriched antiproton beam of the Bevatron. The average mean free path is 18.2 ± 1.8 cm. The annihilation cross sections at five energies are shown. Six proton elastic scattering events are reported. Four events of inelastic scattering on complex nuclei were found. (W.D.M.)

853 AFOSR-TN-58-879

Uppsala Univ. Inst. of Physics.

K^- INTERACTIONS IN FLIGHT. Technical Note No. 2. Å. Frisk and S. Nilsson. [1958]. 8p. Contract AF61(052)-13, phase A. (AD-203909).

Data on K^- meson interactions and decays in flight obtained in two stacks of nuclear emulsion exposed to the 400 Mev/c and 300 Mev/c K^- meson beams of the Bevatron are reported. A total of 1124 K^- tracks were followed. 818 interacted at rest, 212 interacted in flight, and 103 left the stack. In 10 cases the K^- reemerged from the interaction. The interactions in flight are summarized. (W.D.M.)

854 AFOSR-TN-58-880

Uppsala Univ. Inst. of Physics.

DECAY MODES AND LIFETIME OF NEGATIVE HEAVY MESONS. Technical Note No. 3. S. Nilsson and A. Frisk. [1958]. 21p. Contract AF61(052)-13, phase A. (AD-203908).

Twenty-one events representing possible decays of a negative K-meson in emulsion were measured in order to get the relative abundances of different decay modes, an estimate of the contamination from nuclear reactions, and a determination of the mean lifetime. Events consistent with τ^-, $K^-_{\mu 2}$, $K^-_{\mu 3}$, $K^-_{\pi 2}$, $K'^-_{\pi 3}$, and $K^-_{\beta 3}$ were found. The ratio $\tau^-/K^-_L + \tau^- = 0.15$ and $K^-_{\pi 2}/K^-_{\mu 2} = 0.43$. The percentage of nuclear reactions among the events with one charged secondary was ~20%. The mean lifetime $T_{K^-} = (1.50^{+0.45}_{-0.30}) \times 10^{-8}$ sec. Three τ^- are reported and from one τ^- the mass of the negative τ-meson was $m_{\tau^-} = 494.4 \pm 1.2$ Mev. (auth)

855 AEC-tr-3328

π-MESONS. L. M. Barkov and B. A. Nikolskii. Translated for Oak Ridge National Lab. from Uspekhi Fiz. Nauk 61, 341-98(1957). 101p.

Experimental data concerning the properties of pions and their interactions with nucleons and nuclei are summarized and classified. Processes of multiple pion production, which become significant at energies above 1000 Mev, are not considered. (D.E.B.)

856

AIR SHOWERS OF SIZE GREATER THAN 10^5 PARTICLES. 2. CHERENKOV RADIATION ACCOMPANYING THE SHOWERS. M. H. Brennan, J. Malos, D. D. Millar, and C. S. Wallace (Univ. of Sydney). Nature 182, 973-7(1958) Oct. 11.

The feasibility of detecting the Cherenkov pulse associated with an air shower against the background of night sky luminosity is discussed. Results are reported from a series of experiments undertaken to investigate quantitatively the dependence of the Cherenkov light pulse on shower size, and distance of the light receiver from the shower axis. Results indicate that in the interpretation of the light pulses associated with the extensive air showers, it is not justifiable to ignore the angular distribution of the air shower particles and the consequent angular distribution of the emitted photons. As a device for the investigation of possible anisotropies in the directions of arrival of the air shower primaries, the Cherenkov detector pointed to the zenith in conjunction with a particle-detecting array will accept showers within an acceptance cone of half-angle appreciably wider than the half-angle of the detector itself. It is concluded that further investigation is required before one can hope to use the Cherenkov emission from air showers as a means of investigating their longitudinal development. (C.H.)

857

THE ABSOLUTE DENSITY DISTRIBUTION OF COSMIC-RAY AIR SHOWERS AT LOW DENSITIES. H. S. Murdoch (Univ. of Sydney). Nuclear Phys. 8, 157-70 (1958) Sept. (2).

The integral density distribution of cosmic ray air showers was found to be $N(>\rho) = 7.9\rho^{-(1.34+0.018\ln\rho)}$ min^{-1} at ≈ $1m^{-2}$, in agreement with the results of most

other workers at somewhat higher densities. It is shown that the hodoscope method is not valid for determination of the distribution over a range of density and that the deduction by Broadbent et al. of a constant exponent over a wide range of density is erroneous. Good agreement for the absolute rate is obtained from the results of many workers when these are suitably reduced to a common basis as regards range of density, altitude and counter tray separation, the rate quoted being for sea-level and 5 meters separation between trays. (auth)

858

ON THE ANGULAR DISTRIBUTION OF SHOWER PARTICLES GENERATED IN HIGH-ENERGY NUCLEAR INTERACTIONS. G. Bozóki, E. Fenyves, and Éva Gombosi (Central Research Inst. of Physics, Budapest). Nuclear Phys. 8, 199-206(1958) Sept. (2).

The differential and integral angular distributions of shower particles produced in high-energy nuclear interactions are calculated according to the multiple meson production theories of Fermi, Landau, and Heisenberg for nucleon-nucleon interaction. Angular distributions calculated according to the theory of Landau are given for nucleon-nucleus interaction too. It is shown by summarizing the experimental data of jets of energies higher than 10^{13} ev that the angular distribution alone does not show unambiguously which of the multiple meson production theories, if any, is the correct one. (auth)

859

TRANSPORT PHENOMENA IN COMPLETELY IONIZED GAS CONSIDERING ELECTRON-ELECTRON SCATTERING. M. S. Sodha (Univ. of British Columbia, Vancouver, Can.) and Y. P. Varshni (Univ. of Allahabad, India). Phys. Rev. 111, 1203-5(1958) Sept. 1.

Hall mobility and other transport properties of electrons in a completely ionized gas were investigated when a magnetic field is applied, taking into account electron-electron scattering. Results are presented for different mean ionic charges. (auth)

860

PHENOMENOLOGICAL ANALYSIS OF THE PRODUCTION OF PION PAIRS. Ronald F. Peierls (Cornell Univ., Ithaca, N. Y.). Phys. Rev. 111, 1373-9(1958) Sept. 1.

The angular distribution for the production of pairs of pions by photons or pions incident on nucleons is analyzed in terms of the various angular momentum state involved. A general expression is derived and then the effect of various assumptions about which states should be important is examined. It is found that an examination of the relative azimuth of the pions should give information about the nature of the process, and in particular about the existence of a resonant state of the nucleon, and its angular momentum. (auth)

861

TOTAL CROSS SECTION OF HYDROGEN FOR 143- TO 205-Mev POSITIVE PIONS. S. J. Lindenbaum and Luke C. L. Yuan (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. 111, 1380-3(1958) Sept. 1.

Using counter techniques, a higher-precision determination of the $\pi^+ + p$ total cross section in the neighborhood of the $T = J = \frac{3}{2}$ resonance was made. The energy width, statistical errors, and absolute errors were considerably reduced in an extension of our previously reported work. The eight total cross sections which were determined in the pion kinetic-energy range of 143 to 205 Mev are compared to other earlier work and their theoretical interpretation is discussed. (auth)

862

PRODUCTION SPECTRUM OF MESONS IN HIGH-ENERGY NUCLEON-NUCLEON COLLISIONS. M. W. Teucher, D. M. Haskin, and Marcel Schein (Univ. of Chicago). Phys. Rev. 111, 1384-5(1958) Sept. 1.

In order to obtain a production spectrum of mesons in the center-of-mass system, three high-energy nuclear collisions were selected which satisfy very stringent criteria for nucleon-nucleon collisions and for which the momenta of all charged particles could be measured in the laboratory system. The results show that more than one-half of the mesons have energies less than 1 Bev in the center-of-mass system. Only a few particles emitted under very small angles in the forward and backward direction have higher energies, extending up to 10 Bev. The low-energy end of the spectrum is compared with results obtained in experiments with the Berkeley Bevatron. (auth)

863

OBSERVATION OF A π^0-MESONIC DECAY OF A HELIUM HYPERNUCLEUS. R. Levi Setti and W. E. Slater (Univ. of Chicago). Phys. Rev. 111, 1395-7(1958) Sept. 1.

The observation of a hypernucleus decaying into an electron pair, a recoil, and one or more neutral particles, is reported here. The event was produced by a K^- capture in emulsion. The charge of the hypernucleus was determined as Z = 2. The most probable interpretation of this unusual event is the reaction ${}_{\Lambda}He^4 \rightarrow \pi^0 + He^4$. However, ${}_{\Lambda}He^{4,5} \rightarrow \pi^0 + n + He^{3,4}$ cannot be ruled out, since a reliable determination of the energy of the electrons at emission cannot be made. (auth)

864

CLOUD CHAMBER SEARCH FOR PARTICLES IONIZING LESS THAN AN ELECTRON. H. C. Fitz, Jr., William B. Good, James L. Kassner, Jr., and Arthur E. Ruark (Univ. of Alabama, Tuscaloosa). Phys. Rev. 111, 1406-16(1958) Sept. 1.

Since ionization due to a charged particle varies with the square of its charge, a very clean cloud chamber can be used to search for particles having charges, ze, much less than the electronic charge. Similar remarks hold true for magnetic monopoles of relativistic speed. A horizontal cloud chamber was employed to search for such particles. The sensitive time was about 1.5 seconds. The background was at least 60 times less than values commonly reported for "clean" chambers. No subionizers with z in the range $\frac{1}{6}$ to $\frac{1}{2}$ were seen during a time in which about 900 electron tracks were recorded, one million gamma rays traversed the chamber, and 3 million disintegrations were available to give rise to such particles. A vertical chamber 12 in. high was used to look for subionizers in the cosmic ray flux. The background ranged from 0.05 to 1.0 drop per cc, with a usable sensitive time of 0.3 second. Technique for a more limited search was developed; use was made of the fact that background drops are single and well separated, while there are many clumps of ions along a track. No subionizers appeared in a body of photographs containing 550 electron and μ-meson tracks. It was shown by study of "ghost tracks" that neutral nuclei are a major source of the background commonly encountered in tall chambers. (auth)

865

EFFECT OF STRANGE PARTICLES OF MAGNETIC MOMENTS OF NUCLEONS. Suraj N. Gupta (Wayne State Univ., Detroit). Phys. Rev. 111, 1436-8(1958) Sept. 1.

The effect of heavy mesons and hyperons on the

anomalous magnetic moments of nucleons is discussed. The present investigation suggests that (a) K mesons behave as pseudoscalar particles in strong interactions, and (b) there exists a hitherto unobserved highly unstable heavy neutral scalar meson, which is coupled strongly to the nucleons. (auth)

866

CAPTURE RATES FOR NEGATIVE MUONS IN VARIOUS ELEMENTS. A. Astbury, M. A. R. Kemp, N. H. Lipman, et al. (Univ. of Liverpool). Proc. Phys. Soc. (London) 72, 494-8(1958) Oct.

An experiment is described in which the capture rates of negative muons were measured for selected elements. A comparison between the experimental results and the theoretical predictions of Tolkoek and Luyten suggests that tensor and/or axial vector couplings are favored in the interaction. (auth)

867

THE SELF-ABSORPTION OF β RADIATION IN MEASUREMENTS WITH THE 4π COUNTER. H. Meister (Max-Planck-Inst., Göttingen). Z. Naturforsch. 13a, 722-40(1958) Sept. (In German)

The self-absorption of the β radiation in activated foils was investigated for Mn^{56}, Cu^{64}, Pd^{109}, In^{116}, and Au^{198} in a 4π geometry. Metallic foils of various layer thicknesses δ in the solid geometric arrangement were activated in a thermal neutron field. By extrapolation of the specific counting rate $\nu(\delta)$ on zero foil thickness the specific decay rate c was determined and the self-absorption factor $s_\beta(\delta) = \nu(\delta)/c$ was given as a function of the film thickness. For Au^{198} the absolute decay rate N_0 was determined by the β-γ coincidence method and compared with the counting rate N measured in the 4π counter. The self-absorption factor $s_\beta = N/N_0$ agreed within the range of error ($\approx 2\%$) with results obtained previously. Activated foils were covered on both sides with absorbing films of equal thickness x (consisting of the same material) and the transmission of the β radiation $a_\beta(x)$ was measured with 4π counters. The self-absorption in a homogeneous activated film of thickness δ was calculated approximately: $s_\beta = {}^1/_\delta \cdot \int_0^\delta a_\beta(x)dx$. For $\delta < 20$ mg/cm^2 these s_β values agree with those found by extrapolation. For greater film thicknesses increasing deviations appear which are explained by the influence of the β back scattering. Absorption measurement for the conversion electrons of In^{115*} ($E_\gamma = 335$ kev) were made and the results will be compared with theory in a later work. (tr-auth)

868

THE CAPTURE OF NEGATIVE K MESONS BY COMPOUND NUCLEI. W. Alles (Max-Planck Inst., Göttingen). Z. Naturforsch. 13a, 740-5(1958) Sept. (In German)

The interaction of negative K mesons with the compound nuclei of photographic emulsions was analyzed. The Σ^- capture term was studied. 75% showed no charged secondary tracks. The average Coulomb potential of the nuclei capturing the K^- mesons was 8.4 ± 2 Mev. From the energy spectrum of the Σ hyperons, an attracting Σ-nuclear potential $V_\Sigma = -(15 \pm 10)$ Mev results. The emission frequency of the Σ hyperon indicate the Σ-nucleon effective cross section. (tr-auth)

869

THE ANGULAR DISTRIBUTION OF PROTONS IN THE DIRECT NUCLEAR PHOTO EFFECT. J. Eichler and H. A. Weidenmüller (Univ. of Heidelberg, Germany). Z. Physik 152, 261-71(1958). (In German)

The angular distribution of protons, which were emitted by direct E1 absorption from the shell model structure with an angular momentum l, is a superposition of the $l \rightarrow l+1$ and $l \rightarrow l-1$ transitions. While the angular distribution for the "pure" $l \rightarrow l+1$ or $l \rightarrow l-1$ transitions discussed by Courant depends only on l, it was determined in the superposition of both transitions from the radial integrals for dipole absorption. The interference term between the transitions can not be disregarded as it has great influence on the angular distribution. This is in general anisotropic as it would correspond to each of the "pure" transitions. The angular distribution was numerically investigated for p, d, and f protons in a square well potential. Its dependence on the parameters was discussed. The size of the quadrupole contribution was estimated. A better agreement with experiment and a qualitative comprehension of an effect observed by Osokina and Ratner were obtained. (tr-auth)

Heat Transfer and Fluid Flow

870 HW-57383

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

THE AIR COOLING OF PRTR FUEL ELEMENTS DURING EXAMINATION. R. W. Moulton. Sept. 11, 1958. 7p. Contract [W-31-109-Eng-52]. $1.80(ph OTS); $1.80(mf OTS).

A study of air cooling of two types of fuel elements for the Plutonium Recycle Reactor Experiment is presented. The two types of fuel elements are the Mark I, a 19 rod wire-wrapped cluster and the Mark II-B, a concentric ring. Various methods of directing cooling air on the elements was considered in order to obtain the most effective heat transfer. (W.L.H.)

871 KAPL-M-DRM-13

Knolls Atomic Power Lab., Schenectady, N. Y.

CRITICAL FLOW VELOCITIES FOR COLLAPSE OF REACTOR PARALLEL-PLATE FUEL ASSEMBLIES. Daniel R. Miller. Aug. 12, 1958. 37p. Contract W-31-109-Eng-52. $6.30(ph OTS); $3.00(mf OTS).

Theoretical formulas are presented for prediction of the flow velocity at which collapse occurs in long parallel-plate assemblies. Beyond the critical velocity the pressure-unbalance forces developed as a consequence of a small deflection exceed the corresponding elastic restraining forces, and the plates collapse. Both flat- and curved-plate assemblies are considered, and the applicability of the formulas to design of reactor fuel-plate assemblies is discussed. (auth)

872 NDA-80-1

Nuclear Development Corp. of America, White Plains, N. Y.

THE EFFECT OF SPINNING FLOW ON BOILING BURNOUT IN TUBES. E. Oppenheimer. July 30, 1957. 33p. For General Electric Co. Atomic Power Equipment Dept. $6.30(ph OTS); $3.00(mf OTS).

Experiment results are presented from an investigation of the effects of spinning flow on burnout heat flux for water flowing through ${}^1/_4$-in. tubes at low pressures and temperatures. Results indicate benefits on the order of 20% improvement of heat flux for short tubes (for equal pumping power) but not as much as had been anticipated. Heat fluxes as high as 8.5×10^6 Btu/hr-ft^2 were achieved. (auth)

873 WAPD-188

Westinghouse Electric Corp. Bettis Plant, Pittsburgh.

FORCED-CONVECTION HEAT TRANSFER BURNOUT

STUDIES FOR WATER IN RECTANGULAR CHANNELS AND ROUND TUBES AT PRESSURES ABOVE 500 PSIA. R. A. DeBortoli, S. J. Green, B. W. LeTourneau, M. Troy, and A. Weiss. Oct. 1958. 182p. Contract AT-11-1-GEN-14. $3.00(OTS).

A summary of the latest results of the Bettis experimental program and a review and summary of the studies performed by other laboratories are reported. These latest results are the basis for new or revised procedures to be applied to reactor design. A tabulation of all available burnout heat flux data for water under forced circulation conditions and at pressures above 500 psia is presented. This tabulation not only includes all data obtained at Bettis through September 1957, but also all data generally available from other laboratories. These data have been compiled for the convenience of workers in this field. The burnout heat flux, mass velocity, inlet temperature, exit enthalpy, channel geometry, pressure, and other pertinent information are presented for each burnout point. The experimental techniques by which the Bettis burnout data were obtained are described in detail. Descriptions of the Bettis high-pressure loop facilities, test specimens, and method of testing; a detailed sample data reduction calculation; and an analysis of experimental errors are included. The experimental techniques employed by other laboratories have been out-lined. The qualitative effects of mass velocity, inlet temperature, enthalpy at the burnout point, channel geometry, and pressure on burnout heat flux are described. Existing burnout heat flux correlations are discussed, and it is concluded that none provides a completely satisfactory fit of the available data over the entire range of variables covered by the experimental work. Therefore, a new correlation, applicable to pressures near 2000 psia, has been developed and is presented. (auth)

874 AEC-tr-3385

REDUCTION OF FLOW LOSSES IN CHANNELS BY BAFFLES. Kurt Frey. Translated for Oak Ridge Gaseous Diffusion Plant from Forsch. Gebiete Ingenieurw. 50, 105-17(1934). 33p.

Test results for flow resistance of channels with various sharp returns and flares are given. It is proved that the energy losses can be reduced by means of suitable baffles to those of well curved and slender-flared channels. Subdivided baffles are especially effective. Their advantages consist of a lesser material requirement, simple fabrication, and great operating assurance against disturbances in the intake in the case of a low coefficient of friction. Filament observations, flow pictures, and outlines for the design and arrangement of subdivided baffles for economically important channel forms, in addition to reports on successful applications in industry, supplement the experimental results. (auth)

875 AEC-tr-3413

THE TEMPERATURE FIELD IN THE SHEARED CAVITATION REGION. I. G. Portnov. Translated for Oak Ridge National Lab. from Izvest. Akad. Nauk S.S.S.R., Otdel. Khim. Nauk. No. 1, 63-71(1958). 20p.

Corresponding cyclic temperature intensifications are noted, which apparently play a substantial role during the appearance of cavitation shattering of the surface walls, adjacent to cavitation regions that have reached the fatigue limit. The temperature of the phase transition in the problem is assumed to be constant and equal to μ_ξ. The problem is reduced to determining the situations of the isotherm μ_ξ as a function of time. It is assumed that the temperature changes are sufficiently small so that the density ρ, the thermal capacity under constant pressure c, and the thermal conductivity k can be taken as constant. These changes must be such that the influence of the energy dissipation on the temperature field is negligible. (W.D.M.)

Nuclear Properties and Reactions

Refer also to abstract 1018.

876 AECD-4270

Los Alamos Scientific Lab., N. Mex. and Institut for Teoretish Fysik, Copenhagen.

EXCITATION OF NUCLEAR ROTATIONAL MOTION BY NEUTRON SCATTERING. D. M. Chase, L. Wilets, and A. R. Edmonds. [1957]. Decl. Aug. 26, 1957. 57p. Contract [W-7405-eng-36]. $10.80(ph OTS); $3.90 (mf OTS).

The scattering of neutrons by a rotating, deformed, even-even nucleus was investigated, a complex diffuse potential being employed. Two essential approximations, for which justification is presented, are made: (1) Nuclear excitations corresponding to $I \geq 6$ are ignored. (2) In the expansion of the nuclear potential, $V(r,\theta') = \Sigma v_\lambda(r) P_\lambda(\cos\theta')$, terms with $\lambda \geq 4$ are omitted. Comparison with earlier calculations by other authors employing a distorted-wave Born approximation and δ-function interaction indicates that the earlier work seriously overestimated direct excitation. At low energies ($\lesssim 1$ Mev), the excitation cross section given by the direct process is small compared with excitation through the compound nucleus, although the direct process may contribute significantly to the angular distribution due to its large anistropy. The relevance of this work to the measurements by Cranberg and Levin of the differential cross section for excitation of the $I = 2$ first excited level of U^{238} is discussed in some detail. The model is also used to calculate the strength function $\overline{\Gamma}_n^0/D$, the nuclear deformation being varied with A in accordance with experimentally observed quadrupole moments. The fit to experimental values of the strength function is considerably better than that obtained from various other models. (auth)

877 AECU-3703(Rev.)

RAND Corp., Santa Monica, Calif.

FREE-FREE GAUNT FACTORS. W. J. Karzas and R. Latter. Nov. 8, 1957. Revised Oct. 3, 1958. 23p. Contract AT(29-1)-1477. (RM-2010(AEC)(Rev.); AD-156046). $4.80(ph OTS); $2.70(mf OTS).

The hydrogenic (unscreened coulomb) free-free gaunt factors are computed for a wide range of initial energies and photon frequencies. In addition, an average over initial energies with the Maxwell-Boltzmann distribution is performed to give the temperature-averaged gaunt factors for use in opacity calculations. These are presented as functions of Z^2/kT and $h\nu/kT$. The relation between these gaunt factors and the rate of bremsstrahlung energy production is given, as is the total energy emitted as a function of Z^2/kT. (auth)

878 CWR-478

Curtiss-Wright Corp. Research Div., Quehanna, Penna.

URANIUM 235 CROSS SECTIONS FROM A BREIT-WIGNER ANALYSIS. Devereux L. Kavanagh. June 10, 1957. 431p. Contract AT(30-3)-220. $6.00(OTS).

A tabulation of uranium cross sections in the resonance region which should be applicable to the Curtiss-Wright multigroup code as used on the IBM 704 is presented. To gain more useful data in the resonance regions and also to calculate the effect of these reso-

nances on points outside the resonance region, it is suggested that the Breit-Wigner single level formulas be used to resolve the experimental total cross section into its component parts. (A.C.)

879 IDO-16485

Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.

TABLES OF REACTIVITY VS. PERIOD FOR U^{235}, Pu^{239}, AND U^{233}. K. V. Moore. Sept. 10, 1958. 69p. Contract AT(10-1)-205. $2.00(OTS).

Experimentally measured periods can be used in conjunction with the inhour equation to calculate corresponding reactivity changes. Tables of reactivity vs. period were computed on three fuels, based on new (1957) delayed neutron data published by Keepin, Wimett, and Zeigler. There are two tables for each fissionable isotope: one based on the original Keepin, Wimett, and Zeigler data and the other based on a modification of this data. The original data were modified by slightly increasing the delayed neutron fractions to account for the difference in the non-leakage probability occurring between prompt and delayed neutrons in thermal reactors. With the computed values in this report, experimental periods can be related to reactivity. (auth)

880 NAA-SR-2562

Atomics International Div., North American Aviation, Inc., Canoga Park, Calif.

SOME REFINEMENTS IN THE CALCULATION OF RESONANCE INTEGRALS. Jack Chernick and Russel Vernon. Sept. 1, 1958. 42p. Contract AT-11-1-GEN-8. $1.25(OTS).

Two basic formulas for resonance absorption applicable both to mixtures and to lumps are considered: the narrow resonance (NR) approximation and the infinite mass (NRIA) approximation. The formulas are shown to be complementary, yielding accurate results when the choice between them is based on the practical width of the resonance line as originally suggested by Wigner. The formulas are used to calculate resonance integrals for U^{238} and Th^{232}. The results yield a low mass absorption term and a surface absorption term proportional to the square root of the surface-to-mass ratio for lumps of practical size, in quantitative agreement with the experimental work of Egiazarov and Hellstrand for U^{238} and with Dayton and Pettus for thorium. Dresner's suggestion that the ratio of the resonance integral to the mass absorption term is independent of the resonance structure is not borne out. Refinement of the basic formulas is discussed. The correction of the NRIA formula for energy degradation is in agreement with Spinney's calculations for U-H mixtures and with Monte Carlo results obtained by Auerbach for uranium-water lattices. Consideration of lumping effects indicates that the basic formulas generally underestimate the resonance absorption. It is therefore recommended that the common use of ill-defined flux disadvantage factors be dropped. (auth)

881 NP-7000

Pennsylvania. Univ., Philadelphia.

STUDIES IN PHOTONUCLEAR REACTIONS. Annual Report. Physics Dept. Oct. 15, 1958. 11p. Contract AF18(600)-472.

A new method of precise energy control was developed for the 25-Mev betatron. Short-term stability of better than ±4 kev and long-term stability better than ±15 kev were achieved. A paraffin house was constructed for measuring (γ,n) reaction thresholds. The house and its neutron detection system calibration are described. A study of photoneutron thresholds of mono-isotopic and di-isotopic elements was conducted with an estimated accuracy of 50 kev. (D.E.B.)

882

$0^+ \rightarrow 0^+$-TRANSITION IN Ce^{140}. B. S. Dzhelepov, A. P. Prikhodtseva, and Yu. V. Kholnov (Khlopin Radium Inst., Academy of Sciences). Doklady Akad. Nauk S.S.S.R. 121, 995-7(1958) Aug. 21. (In Russian)

An analysis was made of La^{140} γ spectra at ~1900 kev in order to confirm the assumption that the K-1909 conversion electrons correspond to the transition between the excited state of Ce^{140} at 1909 kev with 0^+ quantum characteristics and the ground state (also 0^+). Measurements were made on a γ spectrometer with a lanthanum oxide source irradiated with thermal neutrons. The initial activity of the preparation was 2.8 C. The intensity of 1900-kev γ rays was 4×10^{-4} quanta per decay, which supports the assumption of $0^+ \rightarrow 0^+$ transitions. In order to confirm the presence of the K-1909 line and to determine its intensity, the hard portion of La^{140} conversion electron spectra ($10200 > H\rho > 6400$ and $11500 > H\rho > 10900$) was measured on two β spectrometers; the results are presented graphically. The table of Ce^{140} multiple transitions at 2350, 2529, and 2910 kev is also included. (R.V.J.)

883

NUCLEAR MOMENTS OF INERTIA AND EFFECTIVE NUCLEON MASS. D. R. Inglis (CERN, Geneva). Nuclear Phys. 8, 125-38(1958) Sept. (2).

The nuclear moment of inertia may be calculated as the sum of individual-nucleon contributions by treating the dynamics of one sample nucleon in the ellipsoidal harmonic-oscillator potential representing its interaction with the others, on the plausible assumption that the moment of inertia due to all the other nucleons is simply associated with the orientation of the axes of the distortion ellipsoid. The ellipsoid is allowed to rotate freely (in two dimensions) with conservation of angular momentum, but the treatment is rather similar to that given earlier on the basis of a constant angular velocity of the ellipsoid ("cranked model"), and the result is the same. The moment of inertia has the rigid value when the magnitude of the distortion of an open-shell nucleus is obtained in the most simple manner, by minimizing the sum of the oscillator energies with constant nuclear volume. The analogous problem of linear translation may be similarly treated. The moments of inertia of highly distorted nuclei are observed to be about half of the rigid value. One might hope to understand this discrepancy in terms of the nucleonic "effective mass" $M_e \approx \frac{1}{2}M$ which appears in some problems involving nucleons passing through nuclear matter, and is required in the shell model to reconcile excitation with binding energies. The shell-model-type assumption considered most plausible is that the effective mass arises from simple dependence of the potential not on the canonical momentum but on the nucleon velocity relative to the axes of the rotating ellipsoid, and this is the assumption whose analogue gives a sensible result in the linear problem. The velocity dependence is taken to be a quadratic one, giving a simple expression for M_e. It is shown that, with these assumptions, M_e is not effective for the moment-of-inertia problem and one still obtains the rigid value. (auth)

884

CROSS-SECTIONS FOR (n,p) AND (n,α) REACTIONS OF MAGNESIUM WITH 14.8 Mev NEUTRONS; A NEW ISOTOPE Na^{26}. M. J. Nurmia and R. W. Fink (Univ. of Arkansas, Fayetteville). Nuclear Phys. 8, 139-42(1958) Sept. (2).

Irradiation of natural magnesium metal or highly enriched $Mg^{26}O$ with 14.8 Mev neutrons gives rise to a new activity with a half-life of 1.04 ± 0.03 s which is assigned to Na^{26} from the $Mg^{26}(n,p)$ reaction. The decay appears to proceed mainly by high energy (>5 Mev) β-particles. The reaction cross-section is 50 ± 5 mb, based on a value of 89 mb for the $O^{16}(n,p)N^{16}$ reaction at 14.8 Mev. Simultaneously, the $Mg^{26}(n,\alpha)$ reaction produces well-known Ne^{23} with a cross-section of 89 ± 5 mb, based on the $O^{16}(n,p)$ yield. A new measurement of the Ne^{23} half-life gives a value of 38.0 ± 0.3 s. The cross-section for the $Mg^{25}(n,p)Na^{25}$ reaction is 60 ± 10 mb based on the $O^{16}(n,p)$ reaction. (auth)

885

NEUTRON-DEFICIENT IRIDIUM ISOTOPES. R. M. Diamond and J. M. Hollander (Univ. of California, Berkeley). Nuclear Phys. 8, 143-54(1958) Sept. (2).

A study was made of the isotopes of iridium which are produced from natural rhenium by irradiations with alpha particles in the energy range 25 to 45 Mev. The known iridium isotopes of masses 190, 189, and 188 were observed, and in addition Ir^{187}, Ir^{186}, and Ir^{185} were identified by means of the threshold energy for their production. Analyses are based upon scintillation spectra and conversion electron spectra taken with high-resolution permanent-magnet spectrographs. The interesting situation is encountered in which the three isotopes Ir^{187}, Ir^{186}, and Ir^{185} all have very similar half-lives; Ir^{187}, 13 hours; Ir^{186}, 16 hours; and Ir^{185}, 15 hours. A preliminary study of the radiations from the odd mass isotopes was made, and also some new transitions in Ir^{186}, Ir^{188}, and Ir^{190} are reported. (auth)

886

PHENOMENOLOGICAL TWO-NUCLEON POTENTIALS AND THE DEUTERON. K. V. Laurikainen (NORDITA, Copenhagen). Nuclear Phys. 8, 210-12(1958) Sept.

On the basis of high-energy N-p and p-p scattering experiments, semiphenomenological two-nucleon potentials have been proposed which contain a strong LS-term. Calculations of central and tensor potentials and D-state probability were made in order to test the LS-potential as proposed by Gammel and Thaler. The results show the proposed LS-term is not justified by deuteron theory. (D.E.B.)

887

MAGNETIC MOMENTS OF HIGHLY DEFORMED NUCLEI. J. N. L. Gauvin (Clarendon Lab., Oxford and Université Laval, Quebec). Nuclear Phys. 8, 213-33 (1958) Sept. (2).

It is shown that the values of magnetic moments of odd mass nuclei given by the model of independent particles moving in a spheroidal potential well, deviate from the measured values in a systematic way. The sense of this deviation is such that the calculated values lie between the measured values and strong coupling limits. This behavior can be understood in terms of a polarization of the core of paired nucleons by virtue of their interaction with the odd nucleon; it is found that this mechanism gives a satisfactory account of the ground state moments of Lu^{175} and of Ta^{181}. (auth)

888

FIELD DEPENDENCE OF NEUTRON SCATTERING BY SPIN WAVES. B. N. Brockhouse (Atomic Energy of Canada, Ltd., Chalk River, Ont.). Phys. Rev. 111, 1273-4(1958) Sept. 1.

The energy distribution of neutrons scattered in the vicinity of the 111 reciprocal lattice point of magnetite was measured with and without a magnetic field along the scattering vector. The intensity with a magnetic field was greater than with no field by a factor of 1.41, in approximate agreement with the theoretical value of 1.5, showing that the one-quantum spin wave scattering depends on the orientation of the spin system in the way predicted by theory. For spin waves of very low energy, competing effects of opposite sign apparently exist which render small the over-all effect of a magnetic field on the diffuse scattering. (auth)

889

COUPLING OF ANGULAR MOMENTA IN ODD-ODD NUCLEI. C. J. Gallagher, Jr. (California Inst. of Tech., Pasadena) and S. A. Moszkowski (Univ. of California, Los Angeles). Phys. Rev. 111, 1282-90(1958) Sept. 1.

The coupling of the angular momenta of individual particle states in odd-odd nuclei is shown to be generally describable as spin-spin coupling if the asymptotic-quantum-number description of particle states is used for deformed nuclei. Coupling rules for these nuclei are given, and all available data are treated by them. The results are compared with results based upon a j-j coupling model for a spherical nucleus. A formula based upon the present coupling description is given for calculating magnetic moments of deformed nuclei, and magnetic moments calculated by it are compared to the experimental moments and to those calculated assuming the gyromagnetic ratios of the odd nucleons are those given by the Schmidt formulas. A qualitative theoretical discussion of the basic validity of the coupling rules is given. (auth)

890

RADIATIONS OF Os^{185}. S. S. Malik and Ambuj Mukerji (Franklin Inst., Swarthmore, Penna.). Phys. Rev. 111, 1291-7(1958) Sept. 1.

The radiations of Os^{185} were examined in a thin magnetic lens beta-ray spectrometer and in coincident scintillation spectrometers. By these means, gamma rays of energies 75, 122, 158, 233, 593, 643, 718, 750, 870, and 878 kev were observed, revealing excited energy levels of the residual nucleus, Re^{185}, at 122, 643, 718, 870, and 878 kev. Internal conversion coefficient measurement showed the 643-kev gamma ray to be predominantly E2. A search for positrons was made by observing gamma-gamma coincidences with the counters placed at 180 and 90°. An upper limit of $(4 \pm 3) \times 10^{-6}$ positron per disintegration could be set. (auth)

891

PHOTONEUTRON REACTIONS IN N, O, F, Cu, Ag, AND In. Warren L. Bendel, John McElhinney, and Ralph A. Tobin (U. S. Naval Research Lab., Washington). Phys. Rev. 111, 1297-1302(1958) Sept. 1.

Using an energy scale based on an electrical "zero" and the (γ,n) thresholds of F^{19}, N^{14}, and C^{12}, five (γ,n) thresholds were measured: Ag^{109}, 9.14 ± 0.05 Mev; Ag^{107} to 24-min Ag^{106}, 9.43 ± 0.05; Cu^{65}, 9.89 ± 0.11; Cu^{63}, 10.80 ± 0.04; and In^{115} to 49-day In^{114m}, 9.22 ± 0.10. Breaks, interpreted to be levels in the initial nucleus, were found at 10.47 ± 0.02 Mev in F^{19} and 16.17 ± 0.05 Mev in O^{16}. The observed $O^{16}(\gamma,n)O^{15}$ threshold was in poor agreement with the known Q value. Two half-lives were measured: F^{18}, 1.83 ± 0.02 hours and In^{114m}, 49 ± 1 days. (auth)

892

LOW-LYING EXCITED STATES OF Na^{22}. G. M. Temmer and N. P. Heydenburg (Carnegie Institution of Washington). Phys. Rev. 111, 1303-8(1958) Sept. 1.

Using the singly and doubly ionized helium beams as well as a He^3 beam from an electrostatic generator, the low-lying level structure of Na^{22} in the $F^{19}(\alpha,n\gamma)Na^{22}$ and $Ne^{20}(He^3,p\gamma)Na^{22}$ reactions were studied. One ex-

cited state was found at 666 ± 4 kev in addition to most other states previously discovered in the self-conjugate reaction $Mg^{24}(d,\alpha)Na^{22}$. This state is believed to be 0^+ analog of the ground states of the two neighboring even-even nuclei forming the T = 1 triplet at A = 22. This state decays by a 73-kev transition, having a probable half-life of 0.014 μsec, to the first-excited state of Na^{22} at 593 kev, which in turn decays to the 3^+ ground state with a half-life of 0.266 ± 0.010 μsec. With the plausible assignment of 1^+ for the 593-kev state (0^+ being completely ruled out by the half-life), this would represent a pure M1—pure E2 cascade, whose strengths would be 0.0045 and 0.0077 single-particle units, respectively. The location of the first T = 1 state occurs exactly as expected from a systematic study of the A = 4n + 2 series Coulomb-energy differences, lending additional support to the $I = 0^+$, T = 1 assignment. Proton groups were observed to most previously known states, and one new one at 3.75 Mev. A number of higher energy gamma rays were found in coincidence with those already mentioned. (auth)

B93

INVESTIGATION OF D(d,n)He^3 NEUTRONS AT 8.4 Mev. W. W. Daehnick and J. M. Fowler (Washington Univ., St. Louis). Phys. Rev. 111, 1309-13(1958) Sept. 1.

The angular distribution of neutrons from the reaction D(d,n)He^3 was obtained at 8.4 ± 0.1 Mev incident deuteron energy for center-of-mass angles 2 to 84°. A single plastic crystal was used as a detector and deuterium gas at 200 psi as a target. The distribution is fitted by a sum of Legendre polynomials. It is also compared with the predictions of nuclear stripping theory, and adequate agreement is found with an angular distribution of the form $d\sigma/d\Omega \propto h_{d^2} - \frac{1}{2}h_d h_{d'} + h_{d'^2}$, where the h_d and $h_{d'}$ represent the simple Butler stripping distributions for the incident and target deuterons, respectively. The interaction radius necessary was $R_0 = 7 \times 10^{-13}$ cm. (auth)

B94

RADIATION OF Co^{55}. Ambuj Mukerji, V. S. Dubey, and S. S. Malik (Franklin Inst., Swarthmore, Penna.). Phys. Rev. 111, 1319-24(1958) Sept. 1.

The radiations of Co^{55} were studied in a thin lens magnetic beta-ray spectrometer and in coincident scintillation spectrometers. By observation of the internal conversion lines and the unconverted gamma-spectrum, gamma-rays of energies 1410, 937, 476, and 247 kev were resolved. No other gamma-ray of higher energy decaying with an 18-hr half-life could be observed after careful search of that region using a 4½-in. diam and 4-in. thick NaI(Tl) crystal. The Fermi-Kurie analysis of the positron spectrum yielded three groups of positrons of maximum energies 1510 (51%), 1040 (45%), and 790 (4%) kev. These measurements revealed energy levels of the residual nucleus, Fe^{55}, at 937, 1410, and 1657 kev. (auth)

B95

VARIATIONAL METHODS AND THE NUCLEAR MANY-BODY PROBLEM. R. Brout (Cornell Univ., Ithaca, N. Y.). Phys. Rev. 111, 1324-33(1958) Sept. 1.

The general form of the energy of the ground state of a many-fermion system is shown to be exactly of the form proposed by Brueckner and Bethe, without approximation. In a variational treatment, if the trial wave function is picked containing only pair correlations, together with all possible unlinked pairs, it is described by a two-body excitation matrix $(m_1m_2|A|p_1p_2)$. Variation of this matrix in the Ritz-Rayleigh principle yields a set of integral equations of the scattering type for the matrix A. Hole-state energies are given self-consistently in terms of the matrix A, but particle-state energies are Hartree-Fock energies. This may be corrected for by widely enlarging the class of terms admitted into the wave function. If the approximation is then made of omitting a class of terms, defined as cross-linked clusters in $(\psi|H|\psi)$, the particle-state energies are easily renormalized. Variation then leads to an infinite hierarchy of integral equations. (auth)

B96

CHARGE SPECTROMETRY FOR Xe^{133}-Cs^{133}. Arthur H. Snell and Frances Pleasonton (Oak Ridge National Lab., Tenn.). Phys. Rev. 111, 1338-43(1958) Sept. 1.

The distribution in charge of the product atoms of the radioactive decay Xe^{133}-Cs^{133} was examined under magnetic analysis. The relative intensities are found to be as follows, expressed in percent of the decay events, and going, respectively, from charge 1 through charge 23: 34.1, 3.74, 2.27, 2.15, 2.99, 4.27, 6.14, 9.5, 12.3, 9.0, 6.06, 3.32, 1.76, 1.06, 0.66, 0.32, 0.13, 0.050, 0.014, 0.0075, 0.0027, 0.0013, and 0.0005. In interpreting this charge spectrum, the initial part (charges 1 through 4) is attributed mainly to atoms that escape internal conversion, and the subsequent rise to a maximum at charge 9 and decrease to charge 23 is attributed to atoms that suffer internal conversion. The ratio of the intensities of the two parts of the distribution gives a total internal conversion coefficient for the K, L, and M shells of 1.4, in rough agreement with work of others. Comparison is made with the charge spectrum arising from internal conversion in Xe^{131m}-Xe^{131}, which had previously been measured in the same apparatus. From the low-charge end of the spectrum, the probabilities of electron loss as a result of the beta decay alone are derived as follows: no-electron loss, 0.8; 1-electron loss, 0.08; 2-electron loss, 0.04; 3-electron loss, 0.03. The high-charge side of the spectrum shows a shallow dip in the region of charges 12, 13, and 14, and beyond that point there is relatively more intensity in Xe^{133}-Cs^{133} than there is in Xe^{133m}-Xe^{131}. The difference in shape probably results both from the higher K/(L + M) conversion ratio of Xe^{133}-Cs^{133} as compared with Xe^{131m}-Xe^{131}, and from the fact that the beta emission in Xe^{133}-Cs^{133} introduces electron loss by shake-off. The dip at charges 12, 13, and 14 suggests an underlying structure in the total distribution, comprising subspectra associated with the individual electron shells in which the vacancy cascades originate. (auth)

B97

DISINTEGRATION OF La^{135} AND CONFIRMATORY EXPERIMENTS ON Nd^{147}. Allan C. G. Mitchell, Charles B. Creager, and C. W. Kocher (Indiana Univ., Bloomington). Phys. Rev. 111, 1343-8(1958) Sept. 1.

The disintegrations of La^{135}, Ba^{135m}, and Nd^{147} were studied with the help of magnetic spectrometers and scintillation counters. La^{135} decays almost entirely by electron capture. The half-life was found to be 19.8 ± 0.2 hr. Electron capture to the ground state takes place in 95 to 97% of all disintegrations. Gamma-rays of energies 104, 218, 265, 295, 367, 481, 588, 642, 862 kev were found. There is a very weak positron spectrum. The internal-conversion coefficient of the line at 481 kev was measured. The value $\alpha_K = 0.0130$ indicates an M1 transition. The line at 862 kev has $\alpha_K = 2.5 \times 10^{-3}$. The disintegration scheme is discussed. The internal-conversion coefficient of the line at 265 kev from Ba^{135m} was found to be $\alpha_K = 3.82 \pm 0.2$. The spectrum of Nd^{147} was reinvestigated, confirming the scheme of Hans, Saraf, and Mandeville. The internal-conversion coeffi-

cient for the line at 92 kev was found to be 1.52 ± 0.05. (auth)

898

LEVELS OF Be^{10} AND B^{10}. W. E. Meyerhof (California Inst. of Tech., Pasadena) and L. F. Chase, Jr. (Stanford Univ., Calif.). Phys. Rev. 111, 1348-57(1958) Sept. 1.

The gamma rays produced in the bombardment of Be^9 (thick target) with 2.8-Mev deuterons were measured with a three-crystal pair spectrometer. The gamma rays are assigned in a consistent manner to decay from known levels of Be^{10} and B^{10}. Using information from stripping reactions it can then be inferred that the spins of the 5.96- and 6.26-Mev levels of Be^{10} are 1^- and 2^-, respectively. Furthermore it is shown that the gamma-ray and stripping information is consistent with spins 2^- and 2^+ for the 5.11- and 5.16-Mev levels of B^{10}, respectively, and that the 5.16-Mev level of B^{10} must have a very small alpha-particle reduced width, in accordance with a proposal of Wilkinson and Jones. Reduced widths of many levels of Be^{10} and B^{10} are summarized and analog levels in the two nuclei are searched for and compared. (auth)

899

SPALLATION-FISSION COMPETITION IN HEAVIEST ELEMENTS: HELIUM-ION-INDUCED REACTIONS IN URANIUM ISOTOPES. R. Vandenbosch, T. D. Thomas, S. E. Vandenbosch, R. A. Glass, and G. T. Seaborg (Univ. of California, Berkeley). Phys. Rev. 111, 1358-73(1958) Sept. 1.

A radiochemical study of fission and spallation products produced by bombardment of U^{233}, U^{235}, and U^{238} with 18 to 46 Mev helium ions has been made. As in the case of similar studies using isotopes of plutonium as targets, most of the reaction cross section is taken up by fission. Also, the pronounced increase of the total cross section for (α,xn) reactions with increasing mass number of the target that was observed for plutonium targets is observed for uranium targets. Excitation functions for $(\alpha,2n)$, $(\alpha,3n)$, and $(\alpha,4n)$ reactions are interpreted in terms of compound-nucleus formation and fission competition at the various stages of the neutron evaporation chain. The importance of neutron binding energies for the competition between fission and neutron emission is stressed. An existing model for neutron evaporation following compound-nucleus formation has been extended to include the effect of fission competition. Results of calculations based on this model show good agreement with those features of the (α,xn) excitation functions believed to result from compound-nucleus formation. These calculations also show that fission usually precedes neutron evaporation for helium-ion-induced reactions of U^{233} and U^{235}. The excitation functions for the (α,n), (α,p), $(\alpha,pn+\alpha,d)$, $(\alpha,p2n+\alpha,t)$, and $(\alpha,p3n+\alpha,tn)$ reactions are discussed in terms of direct interaction mechanisms involving little competition from fission. Fission shows an increase in symmetry with energy and becomes symmetric at about 40-Mev energy of the helium ions. There is no significant difference in the symmetry of fission for the three uranium isotopes. Total reaction cross sections, including those for both fission and spallation reactions, indicate a nuclear radius parameter r_0 slightly larger than 1.5×10^{-13} cm. (auth)

900

$C^{12}(p,pn)C^{11}$ CROSS SECTION AT 2 AND 3 Bev. J. B. Cumming, G. Friedlander, and C. E. Swartz (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. 111, 1386-94(1958) Sept. 1.

Absolute measurements of the $C^{12}(p,pn)C^{11}$ cross sections were carried out in the external pencil beam of the Cosmotron at 2 and 3 Bev. The proton flux was measured with a counter telescope, and the C^{11} activity induced in 1-inch-thick plastic scintillators was determined by internal scintillation counting. Corrections for the formation of C^{11} by secondary particles produced in the thick targets were determined in separate experiments in which thin- and thick-target cross sections were compared directly. Other corrections for scattering and absorption effects and for deadtime losses in counters are discussed. Measurements were carried out both at proton fluxes sufficiently low to permit direct counting with the primary telescope and at higher fluxes which required scaling procedures with secondary telescopes. The measured cross sections for the $C^{12}(p,pn)C^{11}$ reaction are 26.0 ± 0.9 and 26.6 ± 1.0 mb at 2.0 and 3.0 Bev, respectively. From these data and from previously published cross-section ratios, the cross section of the $Al^{27}(p,3pn)Na^{24}$ reaction is found to be 10.4 ± 0.6 and 10.0 ± 0.6 mb at 2.0 and 3.0 Bev, respectively. (auth)

901

POSSIBLE EXPERIMENTAL TEST OF UNIVERSAL FERMI INTERACTION. R. Gatto (Istituto Nazionale di Fisica Nucleare, Rome). Phys. Rev. 111, 1426-30(1958) Sept. 1.

The decay modes K_{e3} and $K_{\mu3}$ of charged and neutral K particles are discussed with the aim of deriving, in the Feynman-Gell-Mann-Marshak-Sudarshan theory, possible experimental tests of the hypothesis of universal Fermi interaction, which is already apparently contradicted by the present data on the ratio of $\pi \rightarrow e + \nu$ to $\pi \rightarrow \mu + \nu$. Measurement of the K_3 spectra would already provide a test of the hypothesis, and measurements of the polarizations would give further confirmation. Unique forms of the spectra of the charged leptons are predicted on the basis of the universality hypothesis and of particular assumptions. (auth)

902

MEASUREMENT OF POLARIZATIONS IN STRIPPING REACTIONS. B. Hird, J. A. Cookson, and M. S. Bokhari (Univ. of Liverpool). Proc. Phys. Soc. (London) 72, 489-93(1958) Oct.

The polarization of the protons from the reaction $C^{12}(d,p)C^{13}$ at 6.9 Mev bombarding energy, and from the reactions $Be^9(d,p)Be^{10}$, $B^{10}(d,p)B^{11}$, and $Ca^{40}(d,p)Ca^{41}$ at 8.9 Mev bombarding energy was measured at certain angles of emission. The sign of the polarization was found to be positive when $j_n = l_n + \frac{1}{2}$ and negative when $j_n = l_n - \frac{1}{2}$ except for the reaction $Ca^{40}(d,p)Ca^{41}$. The results of the $C^{12}(d,p)C^{13}$ measurements suggest that the polarization does not vary rapidly with bombarding energy. (auth)

903

ON THE BINDING ENERGY OF THE ^{16}O NUCLEUS. II. HIGHER CLUSTERS. J. Dabrowski (Univ. of Birmingham, Eng.). Proc. Phys. Soc. (London) 72, 499-504(1958) Oct.

A calculation of the higher cluster terms neglected in the variational calculation of the binding energy of the O^{16} nucleus given in an earlier paper is presented. All the different contributions to the next term in the Ursell—Jastrow cluster development are calculated with the help of an approximation based on the short range of the correlations. The wave function found in the earlier paper is used. The numerical results show that both binding and density of the O^{16} nucleus are still reproduced by the two-body interaction with the repulsive core radius between 0.2 and 0.6 fermi. The higher cluster terms are found to be of importance in any attempt at quantitative results. (auth)

904

RADIATIVE CAPTURE CROSS SECTIONS FOR 14.5 Mev NEUTRONS. J. L. Perkin, L. P. O'Connor, and R. F. Coleman (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). Proc. Phys. Soc. (London) 72, 505-13(1958) Oct.

The radiative capture cross sections for 14.5 Mev neutrons were measured for some 30 nuclides selected over a wide range of the periodic table. Chemical procedures were found essential to separate and identify the residual activities arising from capture reactions from the activities caused by the many other competing reactions possible at this neutron energy. Errors due to capture reactions caused by the small percentage of low energy neutrons, which were unavoidably present during the irradiations, were taken into account. The cross sections found were of the order of 5 mb for all except the lightest of the nuclides examined. A plot of these cross sections with respect to neutron number indicates relatively low values for the cross section near magic neutron numbers. These depressions are not so marked as those observed in experiments with fission neutrons. The general level of 5 mb is much higher than the value predicted from some considerations of the theory of the compound nucleus. The consequences of this disagreement are discussed. (auth)

905

DECAY SCHEME AND β SPECTRUM OF MESOTHORIUM 1 (Ra^{228}). G. Goetze and E. Huster (Univ. of Marburg, Ger.). Z. Naturforsch. 13a, 796-7(1958) Sept. (In German)

New measurements on the photon radiation of Ra^{228} confirmed previous results that the number of x L quanta emitted by pure Ra^{228} is much less than 4 for 100 decays. As the possibility existed that the sample contained Ra^{226}, tests were made on a newly decayed Ra^{228} sample. The results showed a line between 12 and 13 kev, but no other lines up to 80 kev. An extrapolation of the increase of the radiation energy with time showed that the energy corresponded with the known amount of Ra^{226} in the sample. The decay of Ra^{228} leads simply to the ground state of Ac^{228}. No conversion lines were found, but only a simple β spectrum of allowed form. The Curie diagram of the spectrum is given, and the upper range of energy was determined to be E_0 = 55 ± 3 kev in good agreement with previous results. (J.S.R.)

906

THE L FLUORESCENCE YIELD OF Tl AND Bi FROM THE DECAY OF Th(B−C−C″). H. Winkenbach (Univ. of Göttingen, Ger.). Z. Physik 152, 387-96 (1958). (In German)

The L x-ray spectrum, which occurs in the Th(B−C−C″) decay, was obtained with a proportional counter. From the intensities determined for the total L radiation from the ThB and ThC compounds and the known ionization of the L shell for the elements Tl and Bi, the average L fluorescence yield valid for the present case was determined for these elements. The value for Bi was f_L = 0.40 ± 0.02. The value for Tl was f_L = 0.32 ± 0.02. The partial fluorescence yield of the L_{III} shell of Tl was determined to be $f_{L_{III}}$ = 0.33 ± 0.02. (tr-auth)

Theory

907

THE THEORY OF THE DIRAC PARTICLE WITH ORIENTED SPIN. A. Sokolow and B. Kerimow (Staatliche Univ., Moscow). Ann. Physik 2, 46-53 (1958). (In German)

It is shown that phenomena which are connected with non-conservation of parity in weak interactions can be investigated by means of the Dirac equations with consideration of spin orientation. (tr-auth)

908

THE COHERENT SCATTERING RADIATION COEFFICIENT IN THE THOMAS-FERMI MODEL. L. Kolonziejczyk (Univ. of Lodz, Poland). Ann. Physik 2, 54-6(1958). (In German)

The scattering radiation coefficient is calculated for free neutral atoms by means of the Rozental approximation of the Thomas-Fermi function. (tr-auth)

909

ON THIRRING'S TWO-DIMENSIONAL MODEL. M. E. Maier and D. V. Shirkov (Joint Inst. of Nuclear Physics). Doklady Akad. Nauk S.S.S.R. 122, 45-7(1958) Sept. 1. (In Russian)

The non-linear theory of spinor fields with Lagrangian interaction was studied on the two-dimensional space-time model. The renormalization group, in the investigated case, has a structure similar to the renormalization group for the non-linear meson theory, obtained from the double charge meson-nucleon theory within the limits of exclusion of meson-nucleon interaction. In contrast to all other field theories, Thirring's model does not lead to the so called "logarithmic pole" difficulty. (R.V.J.)

910

THE PHENOMENOLOGICAL THEORY OF NUCLEAR MATTER. P. Mittelstaedt (CERN, Geneva). Nuclear Phys. 8, 171-90(1958) Sept. (2).

A semi-empirical formulation of the independent particle model for nuclear matter is given. Apart from the energy-dependence of the single-particle potential (effective mass), the rearrangement energy is also taken into account. An extension of this theory for real nuclei is shown to be related to the Weizsäcker-Bethe-formula and to the optical model for nuclear reactions. The undetermined parameters of the theory are adjusted to fit the corresponding experimental material. The single-particle potentials, the rearrangement energies and the optical potentials for protons and neutrons can then be calculated as functions of the neutron excess. The corresponding data for nuclear matter are obtained by taking equal numbers of protons and neutrons. (auth)

911

A MODEL OF THE UNIVERSAL FERMI INTERACTION. J. Leite Lopes (Faculdade Nacional de Filosofia and Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). Nuclear Phys. 8, 234-6(1958) Sept. (2).

It follows from the Feynman-Gell-Mann theory that the Fermi interaction can be regarded as due to an exchange of charged vector mesons between fermions. An alternative model is possible: the weak couplings among fermions may be due to an exchange of charged and neutral vector mesons. An extra condition of conservation of the current which creates the neutral field is imposed to forbid unobserved reactions. The model differs from the Feynman-Gell-Mann picture in that it leads to an intrinsic electron-neutron interaction, the effective potential being of the order of 4 ev. If the coupling of this hypothetical vector meson with fermions has the same strength as the electric charge, the particle will have about 60 proton masses and will decay very fast into pairs of hyperons. (auth)

912

REMARKS ON THE THEORY OF SUPERCONDUC-

TIVITY. Kei Yosida (Univ. of California, Berkeley). Phys. Rev. 111, 1255-6(1958) Sept. 1.

The relation between the Bardeen-Copper-Schrieffer theory and the Bogoliubov theory of superconductivity is discussed. It is shown that the B.C.S. trial wave function is derived by the same transformation as that used by Bogoliubov, and that the integral equation which determines an introduced parameter is equivalent. Some remarks are also made on the excited-state wave functions. (auth)

913

LONGITUDINAL POLARIZATION OF BREMSSTRAHLUNG AND PAIR PRODUCTION. Kirk W. McVoy (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. 111, 1333-7(1958) Sept. 1.

The Born approximation bremsstrahlung (and pair production) cross sections, valid at all energies and angles, are given for all possible states of longitudinal polarization of the particles involved. When the photon-incoming electron angle (θ_0) and the photon-outgoing electron angle (θ) are both zero, a cancellation of Feynman diagrams causes all cross sections to vanish in Born approximation. Further, if both θ_0 and θ are small compared to m^2/E_0^2, the "spin-flip" cross sections are small (of order θ^2) relative to the "non-spin-flip" ones. When account is taken of the above cancellation, angular momentum conservation is sufficient to determine this small-angle behavior, but it explains neither the sign nor the magnitude of the bremsstrahlung circular polarization. (auth)

914

NEW APPROACH TO GENERAL RELATIVITY. Huseyin Yilmaz (Sylvania Electric Products, Inc., Waltham, Mass.). Phys. Rev. 111, 1417-26(1958) Sept. 1.

A generally covariant scalar field theory of gravitation is presented. The principle of equivalence as well as the principle of general covariance are preserved. A functional solution of Einstein's field equations is obtained for the general time-independent case. The theory predicts correctly the results of the three crucial tests of general relativity. Implications concerning the self-energy of point particles are presented. A new theory of cosmology is given and its application to the time-scale problem and to the derivation of the Mach principle is discussed. A new principle called the principle of observation is introduced. (auth)

915

VERTEX FUNCTION IN QUANTIZED FIELD THEORIES. Reinhard Oehme (Univ. of Chicago). Phys. Rev. 111, 1430-2(1958) Sept. 1.

An integral representation is given for the vertex function $F(k^2, p^2, (k-p)^2)$. This representation is obtained on the basis of local commutativity and the spectral conditions. It exhibits the set of points k^2, p^2, for which F is analytic in $(k-p)^2$ except for the physical cut. The limitations found in the representation are discussed on the basis of examples obtained from perturbation theory. These examples give some insight into the question of further analytic continuation in k^2 and p^2. (auth)

916

SCATTERING AMPLITUDES FOR THE THIRRING MODEL. Frederick L. Scarf (Univ. of Washington, Seattle). Phys. Rev. 111, 1433-5(1958) Sept. 1.

The lowest-order covariant equation for the two-particle scattering amplitude in the Thirring model is derived and solved. The results are compared with the exact amplitude, which can be computed by means of Glaser's techniques. The approximate equation contains many spurious solutions which have reasonable asymptotic behavior. Furthermore, some important features of the exact results are not reproduced in any of the ladder-approximation amplitudes. (auth)

917

DELAYED PRODUCT AND BOUND STATE. Kurt Baumann (Max-Planck-Inst., Göttingen, Ger.). Z. Physik 152, 448-53(1958). (In German)

The properties of the field operator products, which are delayed with respect to a random number of simultaneous arguments $z_1 \ldots z_l$, were investigated. They appear when one develops a product $\psi(z_1) \ldots \psi(z_l)$ from the field operators with respect to a contracting field. Their vacuum expectancy values are characterized in the perturbation theory by a generalization of the Dyson double graphs. Random matrix elements are expressed in the presence of bound states by single irreducible double graphs and the single wave functions of the state. The new Tamm-Dancoff equation is assigned as equally to this delayed product as the Bethe-Salpeter equation is to the periodically assigned products. (J.S.R.)

918

COSMIC ELECTRODYNAMICS. J. W. Dungey. New York, Cambridge University Press, 1958. 190p.

A systematic account of the subject of cosmic electrodynamics is presented, and a section on each major topic is included. The physics of the subject is discussed and the mathematical methods are explained, but few extended pieces of mathematics are presented; in particular only the results of Chandrasekhar's extensive work on problems of stability are quoted. An exposition of the theory is given followed by a brief description of the observations in the light of the theory. (W.D.M.)

RADIATION EFFECTS ON MATERIALS

919 AERE-M/M-202

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

THE INFLUENCE OF NEUTRON ENERGY SPECTRUM ON THE PRODUCTION OF IRRADIATION DAMAGE. M. W. Thompson. Aug. 1958. 6p.

A comparison of the damage produced by epithermal and fission neutrons demonstrates the influence of neutron energy spectrum on the rate of production of irradiation damage. Heavy elements are shown to be more sensitive to a change in spectrum than light elements. (auth)

920 AERE-M/TN-52

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

SELECTED UNCLASSIFIED ABSTRACTS ON RADIATION DAMAGE IN SOLIDS (1945–1957). O. Flint, comp. June 1958. 50p.

Approximately 110 abstracted references to published literature are given. (T.R.H.)

921 ANL-5795

Argonne National Lab., Lemont, Ill.

"PIN-CUSHION" IRRADIATION OF CAST URANIUM–PLUTONIUM ALLOY SPECIMENS. S. H. Paine and F. L. Brown. Oct. 1958. 16p. Contract W-31-109-Eng-38. $0.50(OTS).

The irradiation behavior of small pin specimens of chill-cast U–10 wt. % Pu and U–15 wt. % Pu specimens projecting from heat transfer cushions is described. The specimens were coated with a thin layer of carbonyl-deposited nickel. The 15 wt. % Pu pins showed excellent dimensional stability at ⅓ at. % total burnup. The 10 wt. % Pu specimens were somewhat inferior, failure of one of them indicating that the improvement in performance over unalloyed uranium may be due to the restraint imposed by the cladding. (auth)

922 HW-54069
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
THERMAL ANNEALING OF GRAPHITE STORED ENERGY. J. M. Davidson. Mar. 28, 1958. Decl. May 29, 1958. 18p. Contract W-31-109-Eng-52. $3.30(ph OTS); $2.40(mf OTS).

A result of neutron irradiation on graphite is the generation of crystal defects. These defects may take the form of vacancies, interstitial carbon atoms, or groups as well as crystal warpage, general breakup, and resultant stresses. Stored energy is a result of this damage and may be released in annealing processes which result in a more stable arrangement of the graphite lattice. This energy appears as an increased heat of combustion; it may also be measured as an apparent decrease of specific heat. If at any time the stored energy instantaneously becomes greater than the true specific heat, it may possibly take the form of a measurable heat release. The samples used were selected from 30 and 400°C irradiations with exposures up to about 5000 Mwd/at. X-ray measurements of the samples were made at all stages of treatment. (auth)

923 IDO-16477
Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.
METALLURGICAL EXAMINATION OF A MELTED SPERT-I TYPE-B FUEL PLATE. W. O. Schaffnit. Sept. 18, 1958. 18p. Contract AT(10-1)-205. $0.75 (OTS).

Failure in one of the removable SPERT-I Type-B fuel plates was discovered on April 24, 1958, during routine operations that involved removal of fuel plates. The melted plate with two adjacent plates were delivered to the MTR hot cell for metallurgical examination. Macroscopic and microscopic examinations were made. It was concluded that the break resulted from temperatures exceeding the melting points of the 6061 aluminum cladding and the core material. (auth)

924 NDA-9018-1
Nuclear Development Corp. of America, White Plains, N. Y.
IRRADIATION OF HIGH-DENSITY GRAPHITE THERMAL CONDUCTIVITY SPECIMENS IN CAPSULE ATC 2-1 IN THE MATERIALS TESTING REACTOR. D. Lee, G. Foster, and J. Gabay. Feb. 14, 1958. 21p. For Brookhaven National Lab. Contract AT-30-2-GEN-16, Subcontract S-326. $4.80(ph OTS); $2.70(mf OTS).

The development and fabrication of a capsule suitable for the irradiation of graphite specimens in the Materials Testing Reactor (MTR) at Idaho Falls, Idaho, under conditions of a constant sample temperature of 750°F (400°C) at maximum fast neutron flux in an oxygen-free helium atmosphere are described. The test data of primary interest were specimen temperatures, total integrated neutron flux, and nonthermal neutron flux. Great care was taken to avoid damage to the graphite specimens, in order not to invalidate the comparison of post-irradiation data with the elaborate pre-irradiation measurements of weight, dimensions, and thermal conductivity which had been made at BNL. (auth)

925 NP-7007
Shell Development Co., Emeryville, Calif.
DEVELOPMENT OF PROTOTYPE NUCLEAR RADIATION RESISTANT ENGINE OIL. Quarterly Progress Report No. 2 [for] June through August 1958. C. L. Mahoney, W. S. Saari, K. J. Sax, W. W. Kerlin, and E. R. Barnum. 49p. Project No. 8(11-125A)2133. Contract AF33(616)-5617. (S-13761).

Liquid meta-linked polyphenyl ethers continue to show real promise as potential radiation-resistant high-temperature lubricants. They have good physical properties, high minimum spontaneous ignition temperatures and are approximately equivalent to the previously examined para-linked ethers in thermal-, oxidation- and radiation stability. Their lubrication characteristics, as measured in high-temperature Four-Ball tests, are encouraging. The identity and source of unstable contaminants in conventionally prepared samples of meta-linked ethers have been determined. Alternate synthetic routes to avoid formation of these impurities (ring methylated compounds) have been found. Larger samples of these liquid ethers will be prepared and used in expanded testing; especially to obtain additional information on their performance in high-speed gears and bearings. (auth)

926 AEC-tr-3384
DIFFUSION LENGTH OF GRAPHITE. EFFECT OF CYLINDRICAL CHANNELS. (Longueur de Diffusion du Graphite. Effet des Canaux Cylindriques). R. Carle, Clouet d'Orval, R. Lattès, J. Martelly, T. de Mazancourt, C. Robert, M. Sagot, and A. Teste du Bailler. Translated by Liz Appleby (Hanford Atomic Products Operation) from Report CEA-670(B), 1957. 35p.

The diffusion of thermal neutrons generated by a critical pile has been studied in the surrounding graphite. The method of propagation was either homogeneous or pierced by channels for receiving uranium bars. In this case the diffusion is anisotropic and each of the major characteristics decomposes into two principal quantities, the one valid for axial propagation and the other radial propagation. Both of these methods of propagation have been studied in the nearly pure stab in two series of measurements. (A.C.)

927
OPTICAL ABSORPTION OF Cl_2–MOLECULE-IONS IN IRRADIATED POTASSIUM CHLORIDE. C. J. Delbecq, B. Smaller, and P. H. Yuster (Argonne National Lab., Lemont, Ill.). Phys. Rev. 111, 1235-40(1958) Sept. 1.

Pure KCl, KCl-Ag, KCl-Tl, and KCl-Pb, after x-ray irradiation at liquid nitrogen temperature, show identical Cl_2^- paramagnetic resonance spectra. The optical absorption of the Cl_2^- molecule-ion was identified and is found to consist of two bands, one at 365 mμ and one at 750 mμ. This identification was made possible by bleaching irradiated samples with polarized light and observing the effects on the optical and also the paramagnetic resonance spectra. It was possible to reorient the Cl_2^- molecule-ions such that a large fraction of them were in only one of the six possible (110) directions. (auth)

RADIOACTIVE WASTE

928 AECU-3846
Michigan. Univ., Ann Arbor.
UTILIZATION OF ISOTOPIC EXCHANGE FOR RADIO-

CHEMICAL SEPARATIONS. D. N. Sunderman and W. W. Meinke. May 6, 1955. 10p. (M-5682). $1.80 (ph OTS); $1.80(mf OTS).

A rapid, high decontamination, single step method for separation of trace quantities of radioactive species such as silver and iodine has been developed. This method depends upon the rapid exchange between the ion and a thin film of solid silver halide supported on a platinum gauze electrode. High yields of the radioactivity are obtained in a few minutes. Effects on the yield of time, temperature, amount of precipitate, foreign salts, etc., have been studied. Decontaminations (some as high as 10^6) have been determined with tracers of 16 typical elements. By utilizing columns with plates or beads of metal coated with such a precipitate, this method might take its place beside standard engineering operations such as distillation, ion exchange, etc., for trace separation of radioisotopes of a number of elements. (auth)

929 BNL-3868
Brookhaven National Lab., Upton, N. Y.
WASTE PROCESSING STUDIES MONTHLY PROGRESS REPORT [FOR] APRIL 1958. M. Steinberg. May 7, 1958. 10p. $1.80(ph OTS); $1.80(mf OTS).

Two series of tests are presented. One test is concerned with the determination of the adsorptive capacity of molecular sieves for Kr. The other test deals with the solubility of Kr in liquid N_2O. A description of the procedure and a discussion of the results are presented. (W.L.H.)

930 BNL-3877
Brookhaven National Lab., Upton, N. Y.
WASTE PROCESSING STUDIES MONTHLY PROGRESS REPORT [FOR] JUNE 1958. M. Steinberg. July 2, 1958. 4p. $1.80(ph OTS); $1.80(mf OTS).

The solubilities of Kr and Xe as well as the pertinent gases N_2, Ar, and O_2 in liquid N_2O over a range of temperatures from ~85° to −35°C were measured. The solubility of Kr and Xe at low gas phase concentrations decreases with increasing temperatures over the range investigated, while that of N_2, Ar, and O_2 tends to remain fairly constant. (For preceding period see BNL-3876.) (W.L.H.)

931 BNL-3876
Brookhaven National Lab., Upton, N. Y.
WASTE PROCESSING STUDIES MONTHLY PROGRESS REPORT [FOR] MAY 1958. M. Steinberg. June 10, 1958. 3p. $1.80(ph OTS); $1.80(mf OTS).

A preliminary measurement of the solubility of Xe in liquid N_2O at −80°C and at a total pressure of 4.06 atm, using a concentration of 603 ppm Xe in nitrogen, gave a Hevery's Law equivalent solubility value of 60.5 cc (STP)/cc atm. Attempts were made to concentrate the effluent stream of a liquid N_2O solution saturated with a 73.5 ppm Kr−N_2 gas mixture. (For preceding period see BNL-3868.) (W.L.H.)

932 BNL-3878
Brookhaven National Lab., Upton, N. Y.
WASTE PROCESSING STUDIES MONTHLY PROGRESS REPORT [FOR] JULY 1958. M. Steinberg and S. Zwickler. July 30, 1958. 8p. $1.80(ph OTS); $1.80 (mf OTS).

An intensive study of the solubilities of Kr, Xe, N_2O, Ar, N_2, and O_2 in Freon-12 (CCl_2F_2) over a range of temperatures was carried out. Data are presented, and Henery's Law constants are given for the gases in F-12. (For preceding period see BNL-3877.)

933 WAPD-PWR-PMF-311
[Westinghouse Electric Corp. Atomic Power Div., Pittsburgh.]
DESCRIPTION OF THE DECONTAMINATION ROOM WASTE EVAPORATION UNIT. [May 1956]. 5p. Contract [AT-11-1-GEN-14]. $1.80(ph OTS); $1.80(mf OTS).

An evaporator unit with auxiliaries is described which is capable of evaporating continuously an average of 50 gph of radioactive waste over a prolonged period without blowdown. The concentrate is allowed to accumulate and is finally concentrated by means of a steam coil in the evaporator chest. The thick liquor, which is 1 to 2% of the feed volume, is cooled and pumped to a drumming station where it is mixed with cement in 55 gallon drums for sea burial. (C.H.)

REACTORS

General

Refer also to abstracts 976, 977, 992, 1006, and 1029.

934 AERE-R/R-2620
United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.
NEUTRON FLUX MEASUREMENTS IN THE CORE ON LIDO. J. W. Weale, H. R. Mck. Hyder, A. Green, E. D. Jones, C. J. Kenward, and P. J. Oram. July 1958. 47p. $1.26(BIS).

The fast, epithermal, and thermal neutron flux distributions through the core of LIDO have been measured using absolutely calibrated thin foils. By comparing the reaction rates of sodium, manganese, indium, and gold, absolute values have been inferred for the epithermal and thermal fluxes, and some revised cross sections are suggested for manganese and indium. (auth)

935 AGN-3000
Aerojet-General Nucleonics, San Ramon, Calif.
AEROJET NUCLEAR TESTING REACTOR. Summary Hazards Report. Sept. 1958. 150p.

A detailed analysis was made of the potential hazards involved in the operation of the ANTR. The maximum credible accident would be self-limiting and would not release nuclear products dangerous to the general public. (A.C.)

936 CF-54-6-201
Oak Ridge National Lab., Tenn.
A REACTOR DESIGN PARAMETER STUDY. A. H. Fox, M. E. LaVerne, C. S. Burtnette, and C. B. Mills. June 25, 1954. Decl. Sept. 26, 1958. 10p. Contract [W-7405-eng-26]. $3.30(ph OTS); $2.40(mf OTS).

Multigroup calculations were performed on reflector-moderated systems to establish some of the nuclear characteristics of various reflector geometries and materials. C, Li^7, Li^7OD, and NaOD moderators were used with $NaF-UF_4$ fuel. The results are tabulated for 57 moderator and dimensional variations. (D.E.B.)

937 CF-54-8-99
Oak Ridge National Lab., Tenn.
VISIBLE LIGHT PRODUCED IN AIR AROUND REACTORS. J. E. Faulkner. Aug. 30, 1954. Decl. Sept. 26, 1958. 17p. Contract [W-7405-eng-26]. $3.30(ph OTS); $2.40(mf OTS).

An estimate is presented of the amount of visible light

produced by gamma-ray ionization in air such as might exist around a reactor or as might be observed in an accident. An examination is made of the conditions under which a shielded aircraft reactor would produce enough visible light to be seen. A comparison is made with an 18-curie polonium source which produces enough light to be just on the visible threshold. (W.D.M.)

938 HW-55519
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
PERMISSIBLE UNSUPPORTED AREA OF PRTR MARK II FUEL ELEMENT CLADDING. W. E. Roake and M. K. Millhollen. Mar. 17, 1958. 6p. Contract [W-31-109-Eng-52]. $1.80(ph OTS); $1.80(mf OTS).

Void spaces between UO_2 rings and cracks in the tubular fuel element caused by thermal expansion create minor areas of unsupported cladding. Testing of a metal slug and UO_2 fuel rings clad in 3.060 in. OD × 0.030 in. wall Zircaloy-2 tubing under pressures and temperatures equal to, or greater than, proposed PRTR conditions indicates that gaps equal to, or less than, 0.825 in. between sections of fuel may exist without cladding intrusion. (W.D.M.)

939 HW-56069
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
TEMPERATURE COEFFICIENTS OF HETEROGENEOUS U-238–U-235 FUELED REACTORS. E. R. Astley and C. A. Mansius. May 14, 1958. 12p. Contract [W-31-109-Eng-52]. $3.30(ph OTS); $2.40(mf OTS).

An analytical method of determining the effective reactivity coefficient from fundamental cross sections using the four factor formula is presented. Values of the coefficient obtained by this method compare well with experiment. (A.C.)

940 IDO-16463
Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.
MAINTENANCE OF ETR COOLANT. F. C. Haas. Aug. 15, 1958. 11p. Contract AT(10-1)-205. $0.50 (OTS).

Paper presented at Los Angeles Meeting of American Nuclear Society, June 2, 3, 4, and 5, 1958. Report issued as PTR-314 on June 1, 1958.

The ETR is a thermal reactor using ordinary demineralized water as coolant and moderator. Three resin beds are used for activity reduction and to improve the water quality. Design specifications were for water having a specific resistance of one million ohms, but at 175 megawatts the resistance has only been 400,000 to 500,000 ohms. Iron, aluminum, and beryllium are routinely determined and have been of the same order of magnitude as in the MTR. No evidence of nitrogen fixation has been found at 80 Mw. The gross beta-gamma activities are 10,000 at 80 Mw and 40,000 counts per minute per milliliter at 175 Mw. The cation exchanger is removing about 90% of the gross activity; the anion is removing about 30%, and the mixed bed about 97%. Gross water activities are twenty times those found in the MTR before fission breaks occurred. Fission products have been found and identified in the primary water and the gases from the degassing tank. Gaseous activity has necessitated installing a temporary exhaust system on the heat exchanger building and a permanent ventilating system has been designed. The production of gaseous hydrogen and oxygen has presented no problems since the total gas has been 20 to 40 ml/l of water. The primary water is continuously monitored by convection pH and conductivity meters and by a fission break monitor. (auth)

941 IDO-16473
Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.
OPERATIONAL STATUS OF THE ENGINEERING TEST REACTOR AS OF MARCH 1, 1958. J. H. Rainwater. July 31, 1958. 16p. Contract AT(10-1)-205. $0.50 (OTS).

Text of paper (PTR-287) presented at 4th EJC Nuclear Science and Engineering Congress in Chicago, March 1958.

The status of ETR operation as of March 1, 1958, is summarized. Solutions to most of the major problems have been found and the reactor has operated successfully at an 80 Mw power level for 2,000 Mwd. (auth)

942 KAPL-M-DRM-14
Knolls Atomic Power Lab., Schenectady, N. Y.
THERMAL-STRESS RATCHET MECHANISM IN PRESSURE VESSELS. Daniel R. Miller. Aug. 12, 1958. 27p. Contract W-31-109-Eng-52. $4.80(ph OTS); $2.70(mf OTS).

The combination of cyclic thermal stresses and sustained internal pressure in a vessel is shown to be a source of progressive expansion of the vessel if the stresses are sufficiently high. Criteria presented allow determination of limits to be imposed on stresses in order to prevent progressive expansion or to allow estimation of the expansion per cycle where stresses are sufficient to produce growth. (auth)

943 KAPL-M-PGK-1
Knolls Atomic Power Lab., Schenectady, N. Y.
A PRELIMINARY MEASUREMENT OF THE EFFECTIVE DELAYED NEUTRON FRACTION IN FPR-13. P. G. Klann. Aug. 15, 1958. 21p. Contract [W-31-109-Eng-52]. $4.80(ph OTS); $2.70(mf OTS).

A preliminary attempt to measure the effective delayed neutron fraction using the uranium-cadmium composite technique is described. The value found for β_{eff} was 0.0082 ± 12% for FPR-13. The calculated value is 0.0076 for this assembly. The substantial uncertainty stated for this measurement is due to counter difficulties and the small amount of data obtained. The experimental work confirms the theoretical expectation that the precision of the measurement is limited only by experimental errors since all quantities entering the calculation of β_{eff} were directly measured in the experiment and no recourse to calculated quantities was required. The systematic error resulting from neutron scattering from the composite foils is shown to be small by means of an auxiliary measurement with gold foils. (auth)

944 NP-6980
Sylvania-Corning Nuclear Corp., Bayside, N. Y.
BIBLIOGRAPHY OF SOLID FUEL ELEMENTS. (306 Annotated References). Helen C. Friedemann, comp. [1958]. 64p.

Available from Sylvania-Corning Nuclear Corp. ($1.00).

945 NP-6991
Brussels. Centre D'Étude de l'Énergie Nucleaire.
GAS-CLEANING SYSTEMS FOR BR-2. R. Lopes Cardozo and P. Dejonghe. Sept. 10, 1958. 11p.

A study is made of a possible design for a gas-cleaning system for BR-2. The results of the study are shown in tables and graphs. (A.C.)

946 RAG-5
Reaktor A. G., Würenlingen, Switzerland.
DERIVATION OF AN INTEGRAL EQUATION AS AN ALTERNATIVE FUNDAMENT OF REACTOR KINETICS. P. Schmid. May 27, 1958. 37p.

An alternative fundament of reactor kinetics which is immediately connected to the mechanism of the fission chain reaction derived. Green functions are defined for stationary reactors as the response to an instantaneous injection of neutrons. For nonstationary reactors the fission rate is obtained by convolution of the product of reactivity and fission rate with a suitable Green function. By the use of Laplace transformation the solution of most reactor kinetic problems is easily obtained from this integral equation. (auth)

947 RAG-6
Reaktor A. G., Würenlingen, Switzerland.
SIMULATION OF THE DYNAMIC BEHAVIOUR OF THE SWISS D_2O REACTOR DIORIT. H. Albers and B. Walter. May 30, 1958. 52p.

DIORIT is a D_2O moderated, D_2O cooled, testing reactor using 6 tons of natural uranium at a specific power of 2 to 4 Mw per ton. As the effluent from the individual cooling shrouds overflows into the bulk of the moderator a very efficient negative reactivity feedback is expected in the power range. The mechanism of this feedback being of major importance for the dynamic properties, a nuclear reactor simulator containing a special temperature unit was used to investigate the dynamic behavior of DIORIT. A short description is given of the simulator, and some computations on safety aspects are summarized. In particular the influence of fast changes of primary and secondary cooling rates, possible start-up accidents, and the time dependence of power after a fast shutdown are investigated. Transfer functions of the reactor at different power levels are obtained and the performance of the automatic control system is discussed. The results yield a sound basis for the layout of the control and safety circuits and the proper choice of operational conditions. (auth)

948 UCRL-4874(Rev.)
California. Univ., Livermore. Radiation Lab.
THE TIME-DEPENDENT NEUTRON FLUX FOR A PULSED SUBCRITICAL ASSEMBLY. Stanley C. Fultz. Apr. 15, 1957. 17p. Contract W-7405-eng-48. $3.30 (ph OTS); $2.40(mf OTS).

A two-group analysis has been applied to the transient behavior of the thermal flux in a subcritical assembly which has been given a short burst of fast neutrons. A time-dependent function is introduced into the coupling term of the thermal-neutron diffusion equation and a third-order linear differential equation is obtained for the time dependence of the thermal group. The equation can be solved exactly after suitable approximations are made. From the analysis it is possible to interpret rise and decay times of the thermal flux which are obtained experimentally. The method exhibits consistency with critical measurements. (auth)

949 WAPD-T-205
[Westinghouse Electric Corp. Atomic Power Div., Pittsburgh.]
DESIGN OF EQUIPMENT FOR REFUELING A NUCLEAR REACTOR (thesis). Roy I. Bagnall. 1955. Changed from OFFICIAL USE ONLY Sept. 29, 1958. 75p. $12.30(ph OTS); $4.50(mf OTS).

Submitted to the Univ. of Pittsburgh.

The requirements of decay heat removal, radiation shielding, alignment and guiding, and cleanliness for handling equipment are discussed. The design and operation of a loading and unloading machine for a cartridge-type reactor are described. (W.D.M.)

950
FIRST CZECHOSLOVAKIAN REACTOR. Yan Urbanets. Vestnik Akad. Nauk S.S.S.R. 28, No. 6, 82-6(1958) June. (In Russian)

Descriptions are given of a 2 Mwh, water moderated and cooled, U^{235} fueled (up to 10% enriched), research, testing, and isotope production, Russian built reactor. (R.V.J.)

951
REACTOR FUEL PROCESSING. Technical Progress Review, Vol. 1, No. 4. Lemont, Argonne National Laboratory, 1958. 33p. Available from U. S. Government Printing Office for $0.55.

The fuel cycle program is reviewed, and the development of more efficient U^{233}, U^{235}, natural uranium, and plutonium fuels is outlined, together with use of fuels at higher temperature, increased burn-up, and reduction of fuel element production costs. In the Euratom program, the U. S. proposes to reprocess fuels provided by the U. S. to users in the Euratom countries. Details of this program are reviewed. Mechanical and chemical methods for decladding are considered, including pulverizers, sawing methods, and various chemical dissolution procedures. Fuel processing is examined, including Purex and Redox improvements and modifications, studies of organophosphorus and organonitrogen extractants, precipitation processes, and ion exchange. In addition, continued development in uranium hexafluoride volatility processes and pyrometallurgical processing is reported, along with results of HRT and LMFRE development. Metal corrosion by various liquids is examined in the development of materials for use in the corrosive environments associated with solvent extraction processes, fused salt volatility processes, pyrometallurgical processing, waste calcination in fluid beds, and miscellaneous aqueous solutions. Instrumentation and equipment development is reported. Evaluation of the hazards associated with the release of 13 grams of plutonium over a period of 9 years is presented, together with an examination of British disposal of activity to the sea, and absorption of radionuclides by conasauga shale. Finally, a review of new developments in metal production and uranium hexafluoride processing is presented. (J.R.D.)

Power

Refer also to abstract 983.

952 AECU-3854
Brewer Engineering Labs., Marion, Mass.
WATER HAMMER TESTS LOOP ABLE PWR LAND REACTOR, 1957. Given A. Brewer and Joan C. Wing. Feb. 28, 1958. 114p. (M-6529). $18.30(ph OTS); $6.00(mf OTS).

This report essentially substantiates the preliminary data reported in WAPD-PWR-PMF-898.

The Primary Coolant System of the Pressurized Water Reactor (PWR) at Shippingport, Pennsylvania, comprises four loops. Each of the loops has one pump to control the mass rate of water flow. A series of tests were conducted on the cooling system of the PWR land reactor to determine the magnitude and duration of the water hammer pressure wave resulting from check valve closure. The water hammer pressure wave was determined utilizing a high frequency pressure transducer, tapped into the static flow line of Loop Able. In

addition to the pressure cell, a number of electric strain gages were cemented to the Loop Able tubing wall in such a manner that pressure changes within the loop could be determined quantitatively from the strain gage signals. The water hammer pressures determined from the strain gage installations were compared to the values measured by the pressure transducer. (auth)

953 ANL-5881
Argonne National Lab., Lemont, Ill.
A STUDY OF HEAVY WATER CENTRAL STATION BOILING REACTORS (CSBR). M. Treshow, D. Shaftman, L. Templin, M. Petrick, B. Hoglund, and L. Link. Sept. 1958. 81p. Contract W-31-109-eng-38. $2.25(OTS).

Reactors designed for economic operation in stationary central power plants were studied. Certain objectives presented themselves as being of particular importance if an attractive economy were to be obtained. These objectives are: use of ceramic (UO_2) rather than metallic fuel; use of natural uranium; high conversion ratio; long fuel life; natural convection for heat transfer; production of superheated steam; a high power output; a limited size of pressure tank; fuel handling without use of large pressure lid; and moderator control. Three different types of power reactors are presented; a natural uranium, boiling heavy water reactor with forced circulation; a boiling reactor with natural convection and slightly enriched fuel; and two heavy water boiling and superheating reactors using slightly enriched fuel and natural convection. A chapter on summarized operating data indicates the degree of success achieved in meeting the objectives. (D.E.B.)

954 APAE-7
Alco Products, Inc., Schenectady, N. Y.
REACTOR ANALYSIS FOR THE ARMY PACKAGE POWER REACTOR NO. 1. J. G. Gallagher, ed. May 29, 1956. Decl. Oct. 7, 1958. 136p. Contract AT(11-1)-318. $21.30(ph OTS); $6.90(mf OTS).

The reactor analysis of the critical experiment and the APPR-1 resulted in a loading of the APPR-1 of 21.098 gm of B-10 with 22.5 kg U-235. This loading will result in adequate reactivity for a core life of 13 MWYR based on uniform burnup of U-235 and B-10. Calculations indicate that five of the seven control rods provided are more than adequate to shut the reactor down at any time. The temperature coefficient of reactivity should be at least -2×10^{-4} $\Delta K/°F$. (auth)

955 ASAE-S-8
American-Standard. Atomic Energy Div., Mountain View, Calif.
PLUTONIUM RECYCLE IN THE CALDER HALL TYPE REACTOR. L. J. Barbieri, J. W. Webster, and K. T. Chow. Jan. 1, 1958. 116p. Project SIZE-UP. Contract AT(04-3)-109. $2.50(OTS).

The economics and physics of four schemes of plutonium recycle in the Calder Hall type reactor are considered. The four possible schemes are: (1) to blend the Pu produced in a run with fresh natural U for a subsequent run; (2) to alloy the Pu with some diluent metal and fabricate the alloy into high heat-transfer elements more like MTR or PWR-seed type elements and "spike" a subsequent load of fresh natural U elements with these Pu elements; (3) to recycle half the spent U as well as the Pu; and (4) to take advantage of the extra reactivity gained from the recycled Pu to decrease the lattice spacing, thereby increasing the conversion ratio with the hope of increasing the attainable exposure. It was concluded that scheme (1) is the most economical. (W.D.M.)

956 BAW-9(Rev. 3)
Babcock and Wilcox Co. Atomic Energy Div., Lynchburg, Va.
CORE DESIGN AND CHARACTERISTICS CONSOLIDATED EDISON REACTOR. Aug. 18, 1958. 36p. For Consolidated Edison Co. of New York, Inc. $6.30(ph OTS); $3.00(mf OTS).

The core design and characteristics of the Indian Point Power Reactor of the Consolidated Edison Co. are presented. The latest changes in the core design and materials are discussed. The fuel cladding material was changed from Zircaloy-2 to stainless steel (304). The design power level of 500 Mwh was changed to 585 Mwh. The accompanying changes in reactivity are discussed. (W.D.M.)

957 CEND-0005-RS-25
Combustion Engineering, Inc. Nuclear Div., Windsor, Conn.
SUMMARY OF PROGRESS IN UNCLASSIFIED AREAS OF REACTOR TECHNOLOGY. June 16, 1958. 13p. $3.30(ph OTS); $2.40(mf OTS).

Two papers are presented: Expansion in Legendre Polynomials and Step Functions, and Evaluation of the X-Ray Fluorescent Spectrometric Determination of Uranium in Zircaloy-2 Fuel Alloy. In the former, the possible kinds of fundamental sets for series expansion of the flux $f(x,\mu)$ ranging from the single to double spherical harmonics method are indicated. The equations are simplified to an orthogonal set by the Gramm-Schmidt process and an example problem is solved. The results are compared with other methods, and the relative merits of different fundamental sets are discussed. The latter paper reports that the method can give an error of $\pm 1\%$ at the 99-99 confidence level if instrumental and sample errors can be controlled. Particular sources of instrumental and sample variability are pointed out. (See also CEND-0005-RS-17.) (T.R.H.)

958 CF-55-3-31
Oak Ridge National Lab., Tenn.
CHEMICAL PROCESSING AND FUEL COSTS FOR THE REVISED THERMAL BREEDER REACTOR. E. D. Arnold. Mar. 3, 1955. Decl. Sept. 26, 1958. 8p. Contract [W-7405-eng-26]. $1.80(ph OTS); $1.80(mf OTS).

The procedure for processing the blanket of the reactor is described, including the removal of high cross section fission products. An estimate of the process rate is given along with an estimate of operating cost and the fixed investment. (J.R.D.)

959 CRNE-803
Atomic Energy of Canada Ltd. Chalk River Project, Chalk River, Ont.
HIGHLY RELIABLE CONTROL SYSTEMS FOR A 200-MW POWER REACTOR. E. Siddall. July 1958. 34p. (AECL-685). $1.50(AECL).

Studies are underway in Canada for a power reactor (CANDU) to be fuelled with natural uranium and to produce 200 Mwe. This reactor would be moderated by heavy water at approximately atmospheric pressure and at a temperature below 200°F. The moderator in the core is contained in a cylindrical aluminum "calandria" with its axis horizontal. A large number of thin-walled aluminum tubes run from end to end of the cylinder so that the calandria resembles a fire-tube boiler. Through each calandria tube runs a separate Zircaloy pressure tube which contains coolant and fuel at a temperature around 500°F. The whole core is located under a main shielding floor. Steam raisers and fuel-changing gear make access to the sides difficult and to the ends almost impossible. The reactor

will be operated with a very small margin of excess reactivity so that unless special measures are adopted, a stoppage lasting more than a few minutes will be prolonged into a long shutdown by the build-up of Xe-135. (auth)

960 NAA-SR-2558

Atomics International Div., North American Aviation, Inc., Canoga Park, Calif.

11,400 KW NUCLEAR POWER PLANT EMPLOYING AN ORGANIC MODERATED REACTOR. Preliminary Description. C. W. Wheelock, ed. [Nov. 1, 1957]. 80p. Contract AT-11-1-GEN-8. $2.75(OTS).

The preliminary design is presented for a 11.4 Mwe power plant powered by an organic moderated heterogeneous reactor. The fuel elements are slightly enriched, aluminum clad, metallic uranium alloy. System and component requirements are discussed and possible design configurations and equipment are described. (W.D.M.)

961 RAG-4

Reaktor A. G., Würenlingen, Switzerland.

DIPHENYL COOLED, HEAVY WATER MODERATED, NATURAL URANIUM REACTOR PROTOTYPE. W. Hälg and Th. Schaub. May 30, 1958. 42p.

Calculations were performed for the physical and thermodynamical data for a heavy water moderated, natural uranium metal fueled, and diphenyl cooled power prototype reactor. The moderator temperature will be kept lower than 80°C, the cooling fluid circulates on both sides of the tubular uranium rods with a mean temperature of 300°C. The cladding material for the fuel is a magnesium alloy, the cooling liquid however flows within a pressure tube made of sintered aluminum powder, which guarantees the necessary tensile strength at elevated temperatures. Two group calculations give the bucklings for various dimensions of the lattice, such as uranium tube width, diameters of inner and outer cooling paths, thermal insulation, and fuel rod spacing. Xenon and samarium saturation poisoning effects as well as operating temperatures are included in the given results. Xenon override and uranium burnup were introduced as an additional amount of 2% δk. Thermodynamic calculations optimize the geometry of the cell for best heat transfer under assumed limiting values for maximum fuel temperature, coolant flow velocities and mean cooling temperature difference between inlet and outlet. This optimum lattice is then used to determine the dimensions of a cylindrical reactor with radial reflector. For a low cost power prototype reactor a minimum heavy water volume will be in favor. (auth)

962 WAPD-MRP-75

Westinghouse Electric Corp. Bettis Plant, Pittsburgh.

PRESSURIZED WATER REACTOR (PWR) PROJECT TECHNICAL PROGRESS REPORT FOR THE PERIOD JUNE 24, 1958 TO AUGUST 23, 1958. 82p. Contract AT-11-1-GEN-14. $2.25(OTS).

Analysis of plant performance at reduced coolant temperature and pressure was completed, and new set points for reactor plant operation and protection were determined. The instrumented Seed-2 cluster weldment and control rod shroud designs were established. To obtain mixing of coolant in the inlet plenum chamber, a baffle configuration was selected which creates and maintains vortex flow in the lower plenum. The properties of Zircaloy-2 castings of the type considered for use in PWR cores were found to be comparable to those of hot-rolled strip and welded structures. A development pilot run was completed in which a total of 35,000 natural UO_2 fuel inserts were compacted. Dimensional tolerance and density data are given. Hydrogen analyses of nickel-diffusion-bonded Zircaloy-2 and normal Zircaloy-2 irradiated in MTR resulted in maximum hydrogen pickups of 2900 ppm in the former and 44 ppm in the latter, indicating the strong effect of nickel content on hydrogen absorption. A defected, copper-diffusion-bonded UO_2 plate exposed in the WAPD-29 loop was examined. Uniform dispersions of FeB_2 in iron were fabricated with controlled, coarse boride particle size without reaction with the surrounding matrix material. A one-dimensional model was developed which gave reasonable agreement with data obtained from oscillation tests at Shippingport. A two-dimensional reactivity lifetime calculation for the Core-2 design was completed. The temperature coefficient of reactivity for a hot, beginning-of-life Core-2 design was calculated under the assumption that a lumped burnable poison was present. (For preceding period see WAPD-MRP-74.) (W.D.M.)

963 WAPD-PWR-PC-1348

[Westinghouse Electric Corp. Bettis Plant, Pittsburgh.]

ROD WITHDRAWAL TRANSIENTS. E. A. Wieczorkowski. [1958]. 36p. $6.30(ph OTS); $3.00 (mf OTS).

Results of an analog computer study of rod withdrawal transients for both power and subpower operation of the Shippingport Pressurized Water Reactor Power Plant are given. These results are expected to compare with period V test data, the Controlled Safety Test-Rod Withdrawal Transients. It is concluded that insofar as boiling and burnout are concerned, safe conditions will prevail even if the reactor protection system fails. (T.R.H.)

964 WAPD-PWR-PCR-207

[Westinghouse Electric Corp. Atomic Power Div., Pittsburgh.]

PWR TRAINING SIMULATOR DESIGN DESCRIPTION. G. L. Hartfield and A. I. Moss. Sept. 15, 1956. 12p. $3.30(ph OTS); $2.40(mf OTS).

The analog computer, control console, and remote control panel of the Shippingport Pressurized Water Reactor training simulator are described. (T.R.H.)

965 WAPD-PWR-PMA-1317

Westinghouse Electric Corp. Atomic Power Div., Pittsburgh.

18-INCH HYDRAULICALLY-OPERATED MAIN STOP VALVE DESIGN. Equipment Specification 565311-F. M. L. Sloman. Apr. 19, 1957. 2p. Project PWR. Contract AT-11-1-GEN-14. $1.80(ph OTS); $1.80(mf OTS).

Certain parts of the 18-in. hydraulically-operated main stop valve of the Shippingport Pressurized Water Reactor were redesigned to protect the valve under conditions of 3000 psi differential pressure across the opening piston. The test procedure and results for the redesigned valve are given. (T.R.H.)

966 WAPD-PWR-PMF-278(Issue 2)

Westinghouse Electric Corp. Atomic Power Div., Pittsburgh.

PWR RADIOACTIVE WASTE DISPOSAL SYSTEM. ACTIVITY BALANCE. July 16, 1956. 9p. Contract AT-11-1-GEN-14. $1.80(ph OTS); $1.80(mf OTS).

An activity balance was developed for the PWR Radioactive Waste Disposal System to show the degree of radioactive contamination of wastes throughout the process and outside the control area. (auth)

967 WAPD-PWR-PMF-360

Westinghouse Electric Corp. Atomic Power Div., Pittsburgh.

PWR RADIOACTIVE WASTE DISPOSAL PLANT.

[1956]. 7p. Contract AT-11-1-GEN-14. $1.80(ph OTS); $1.80(mf OTS).

Criteria used in the design of the Radioactive Waste Disposal System for the Shippingport Pressurized Water Reactor are presented. (W.L.H.)

968 YAEC-60

Yankee Atomic Electric Co., Boston.

PRELIMINARY HAZARDS SUMMARY REPORT. PART B. LICENSE APPLICATION. (AEC Docket No. F-29; Filed as Amendment No. 3). Apr. 1957. 286p. $4.00 (OTS).

The proposed Yankee Atomic Electric Company Reactor is a pressurized light water reactor plant designed to produce ultimately 492 Mw of heat and 134 Mw of net electrical generation at full power. The initial core to be operated in the reactor is designed to produce 392 Mw of heat at full power which provides approximately 110 Mw of net electrical generation. The reactor is fueled with slightly enriched uranium dioxide UO_2, in the form of pressed and sintered 0.3 in. diameter cylindrical compacts stacked in 0.336 in. OD full length stainless steel tubes in a core 7.5 ft. in height. The reactor is cooled and moderated by light water. The design is subject to change in detail before manufacture. Design characteristics and reactor safeguard considerations are described. (C.H.)

969 YAEC-72

Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh.

STUDIES OF THERMAL BEHAVIOR UNDER LOSS OF PUMP POWER TRANSIENT CONDITIONS. A. Bournia. Sept. 22, 1958. 25p. For Yankee Atomic Electric Co. Contract AT(30-3)-222, Subcontract No. 1. $4.80(ph OTS); $2.70(mf OTS).

Transient studies were made for three types of loss of coolant flow accidents. These consisted of a one pump loss of flow, a simultaneous two pump loss of flow, and a simultaneous four pump loss of flow for the Yankee first and 482 Mw cores. Assumptions and methods of solution are given for each case. Cursory calculations were made for the one pump and four pump accidents to be used as check values for the initial analog computer analyses. The two pump accident was analyzed to provide more detailed information on the behavior of the hot channel during bulk boiling, taking into account the redistribution of flow in the open lattice. Based on the suppositions used in the two pump loss of flow accident analysis, no difficulties are foreseen for this transient accident condition. (auth)

970

BOILING WATER REACTORS. Andrew W. Kramer. Reading, Mass., Addison-Wesley Publishing Company, Inc., 1958. 572p. $8.50.

The history, development, and technology of the boiling water reactor are discussed. The physics underlying boiling reactor design is reviewed. Detailed descriptions are given of the various BORAX experiments, Experimental Boiling Water Reactor, Vallecitos Boiling Reactor, and the Dresden Power Reactor. (W.D.M.)

STABLE ISOTOPE SEPARATION

971 AERE-C/R-2670

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

A LIST OF BATCHES OF ELECTROMAGNETICALLY ENRICHED ISOTOPES IN STOCK FOR STABLE ISOTOPES LOAN POOL. M. L. Smith. Aug. 1, 1958. 9p.

The electromagnetically enriched stable isotopes available for loan to United Kingdom universities by the Atomic Energy Research Establishment, Harwell, are listed, and the conditions for loaning are outlined. (T.R.H.)

TECHNOLOGY

Feed Materials

972 SRO-11

Horizons, Inc., Cleveland.

RESEARCH AND DEVELOPMENT IN THE FIELD OF THORIUM CHEMISTRY AND METALLURGY. VOLUME I. PREPARATION OF ELECTROLYTIC CELL FEED FOR PRODUCTION OF THORIUM METAL. Final Report. Charles E. Fisher and James L. Wyatt. June 30, 1956. Decl. June 6, 1957. 140p. Contract AT(30-1)-1335. (HZ-98). $2.75(OTS).

A research and development program in the field of thorium chemistry and metallurgy was conducted. Most of this activity was directed toward the development of techniques for the production of metal by fused salt electrolytic approaches, little effort being proportioned to the preparation of an electrolyte for the process. An aqueous method for the preparation of an anhydrous cell feed was set up and operated for several months. Relatively high operating expense and difficulties with materials of construction prompted the development of a more direct approach for the production of electrolytic cell feed. The system established for cell feed preparation converts thorium nitrate to a basic carbonate via the reaction between the nitrate and sodium carbonate, this precipitation being quantitative. Following a suitable filtration and drying operation, the thorium oxycarbonate is converted directly to the chloride by reaction with carbon and chlorine, forming a cell feed containing between 40 and 45% thorium in a molten matrix of sodium and potassium chlorides. The preparation of cell feed by the described process was carried out on a small-tonnage basis, in 1,000-pound batches. The entire process is capable of being operated on a continuous or semi-continuous basis and presents a commercially feasible approach for the preparation of high quality anhydrous electrolytes suitable for conversion to A.E.C. grade thorium metal by electrolytic techniques. A brief description of small-scale research and development experiments leading to the established system also is included. (auth)

Raw Materials

Refer also to abstracts 979, 980, and 1011.

973 WIN-53

National Lead Co., Inc. Raw Materials Development Lab., Winchester, Mass.

REMOVAL OF MOLYBDENUM FROM ACID LEACH LIQUORS BY ACTIVATED CARBON. E. T. Hollis and H. E. Dixon. July 29, 1958. 26p. Contract AT(49-6)-924. $4.80(ph OTS); $2.70(mf OTS).

Data are presented on the adsorption of molybdenum on activated carbon. The effect of retention time and linear flow on adsorption, the use of sodium hydroxide as an eluant, and the possibility of recovering molybdenum from the caustic eluate are discussed. (auth)

974 WIN-103

National Lead Co., Inc. Raw Materials Development Lab., Winchester, Mass.

CONTROL OF ORGANICS IN CARBONATE LEACHING CIRCUITS. D. R. George and J. T. Lynch. July 25, 1958. 35p. Contract AT(49-6)-924. $6.30(ph OTS); $3.00(mf OTS).

The results of experiments with methods of controlling soluble organics in the carbonate leaching of uranium ores are described. The methods studied include the uses of adsorbents, chemical oxidants, precipitants, electrolytic oxidation, and air oxidation by high-temperature autoclaving. (auth)

975 WIN-108

National Lead Co., Inc. Raw Materials Development Lab., Winchester, Mass.

ALKALINE LEACH–FILTRATION PILOT PLANT TESTING OF HOLLY MINERALS COMPANY ORE. H. E. Dixon and G. Winslow. June 9, 1958. 43p. Contract AT(49-6)-924. $7.80(ph OTS); $3.30(mf OTS).

During the period of February 15 through April 1, 1958, Holly Minerals Company ore from the Ambrosia Lake District of New Mexico was treated in the Alkaline Leach–Filtration Pilot Plant at Grand Junction, Colorado. The report contains detailed information on grinding, leaching, filtration, and precipitation in connection with the processing of this ore. Both autoclave and Pachuca leaching were employed. Results show the ore to be amenable to the Alkaline Leach–Filtration process. (auth)

PATENTS

976

QUICK RELEASABLE DRIVE. J. J. Dickson (to U. S. Atomic Energy Commission). U. S. Patent 2,841,018. July 1, 1958.

A quick releasable mechanical drive system suitable for use in a nuclear reactor is described. A small reversible motor positions a control rod by means of a worm and gear speed reducer, a magnetic torque clutch, and a bell crank. As the control rod is raised to the operating position, a heavy coil spring is compressed. In the event of an emergency indicated by either a "scram" signal or a power failure, the current to the magnetic clutch is cut off, thereby freeing the coil spring and the bell crank positioner from the motor and speed reduction gearing. The coil spring will immediately act upon the bell crank to cause the insertion of the control rod. This arrangement will allow the slow, accurate positioning of the control rod during reactor operation, while providing an independent force to rapidly insert the rod in the event of an emergency.

977

NUT SCREW MECHANISMS. J. A. F. Glass (to U. S. Atomic Energy Commission). U. S. Patent 2,841,026. July 1, 1958.

A reactor control mechanism is described wherein the control is achieved by the partial or total withdrawal of the fissile material which is in the form of a fuel rod. The fuel rod is designed to be raised and lowered from the reactor core area by means of two concentric ball nut and screw assemblies that may telescope one within the other. These screw mechanisms are connected through a magnetic clutch to a speed reduction gear and an accurately controllable prime motive source. With the clutch energized, the fuel rod may be moved into the reactor core area, and fine adjustments may be made through the reduction gearing. However, in the event of a power failure or an emergency signal, the magnetic clutch will become deenergized, and the fuel rod will drop out of the core area by the force of gravity, thus shutting down the operation of the reactor.

978

PRECIPITATION METHOD OF SEPARATION OF NEPTUNIUM. L. B. Magnusson (to U. S. Atomic Energy Commission). U. S. Patent 2,841,464. July 1, 1958.

A process is described for the separation of neptunium from plutonium in an aqueous solution containing neptunium ions in a valence state not greater than +4, plutonium ions in a valence state not greater than +4, and sulfate ions. The process consists of adding hypochlorite ions to said solution in order to preferentially oxidize the neptunium and then adding lanthanum ions and fluoride ions to form a precipitate of LaF_3 carrying the plutonium, and thereafter separating the supernatant solution from the precipitate.

979

URANIUM EXTRACTION. C. D. Harrington and J. V. Opie (to U. S. Atomic Energy Commission). U. S. Patent 2,841,466. July 1, 1958.

The recovery of uranium values from uranium ore such as pitchblende is described. The ore is first dissolved in nitric acid, and a water soluble nitrate is added as a salting out agent. The resulting feed solution is then contacted with diethyl ether, whereby the bulk of the uranyl nitrate and a portion of the impurities are taken up by the ether. This acid ether extract is then separated from the aqueous raffinate, and contacted with water causing back extraction of the uranyl nitrate and impurities into the water to form a crude liquor. After separation from the ether extract, this crude liquor is heated to about 118°C to obtain molten uranyl nitrate hexahydrate. After being slightly cooled the uranyl nitrate hexahydrate is contacted with acid free diethyl ether whereby the bulk of the uranyl nitrate is dissolved into the ether to form a neutral ether solution while most of the impurities remain in the aqueous waste. After separation from the aqueous waste, the resultant ether solution is washed with about 10% of its volume of water to free it of any dissolved impurities and is then contacted with at least one half its volume of water whereby the uranyl nitrate is extracted into the water to form an aqueous product solution.

980

RECOVERY OF URANIUM FROM CARBONATE LEACH LIQUORS. H. F. Wilson (to U. S. Atomic Energy Commission). U. S. Patent 2,841,468. July 1, 1958.

An improved process is described for the recovery of uranium from vanadiferous ores. In the prior art such ores have been digested with alkali carbonate solutions at a pH of less than 10 and then contacted with a strong base anion exchange resin to separate uranium from vanadium. It has been found that if the exchange resin feed solution has its pH adjusted to the range 10.8 to 11.8, that vanadium adsorption on the resin is markedly decreased and the separation of uranium from the vanadium is thereby improved.

981

PLUTONIUM CARRIER METATHESIS WITH ORGANIC REAGENT. Stanley G. Thompson (to U. S. Atomic Energy Commission). U. S. Patent 2,841,469. July 1, 1958.

A method is described for converting a plutonium containing bismuth phosphate carrier precipitate into a composition more readily soluble in acid. The method consists of dissolving the bismuth phosphate precipitate in an aqueous solution of alkali metal hydroxide, and adding one of a certain group of organic compounds, e.g., polyhydric alcohols or a-hydroxycarboxylic acids. The mixture is then heated causing formation of a bismuth hydroxide precipitate containing plutonium which may be readily dissolved in nitric acid for further processing.

982

HEAT TREATMENT OF ELECTROPLATED URANIUM. P. F. Hoglund (to U. S. Atomic Energy Commission). U. S. Patent 2,841,539. July 1, 1958.

A method is described for improving electroplated coatings on uranium. Such coatings are often porous, and in an effort to remedy this, the coatings are heat treated by immersing the coated specimen in a bath of fused salt or molten metal. Since the base metal, uranium, is an active metal, such a procedure often results in reactions between the base metal and the heating medium. This difficulty can be overcome by using liquid organopolysiloxanes as the heating medium.

983

POWER REACTOR. W. H. Zinn (to U. S. Atomic Energy Commission). U. S. Patent 2,841,545. July 1, 1958.

A fast nuclear reactor system is described for producing power and radioactive isotopes. The reactor core is of the heterogeneous, fluid sealed type comprised of vertically arranged elongated tubular fuel elements having vertical coolant passages. The active portion is surrounded by a neutron reflector and a shield. The system includes pumps and heat exchangers for the primary and secondary coolant circuits. The core, primary coolant pump and primary heat exchanger are disposed within an imperforate tank which is filled with the primary coolant, in this case a liquid metal such as Na or NaK, to completely submerge these elements. The tank is completely surrounded by a thick walled concrete shield. This reactor system utilizes enriched uranium or plutonium as the fissionable material, uranium or thorium as a diluent and thorium or uranium containing less than 0.7% of the U^{235} isotope as a fertile material.

984

QUANTIZING TUBE. A. S. Jensen and George W. Gray (to U. S. Atomic Energy Commission). U. S. Patent 2,841,727. July 1, 1958.

Beam deflection tubes are described for use in switching or pulse amplitude analysis. The salient features of the invention reside in the target arrangement whereby outputs are obtained from a plurality of collector electrodes each corresponding with a non-overlapping range of amplitudes of the input signal. The tube is provided with means for deflecting the electron beam along a line in accordance with the amplitude of an input signal. The target structure consists of a first dynode positioned in the path of the beam with slots spaced along the deflection line, and a second dynode positioned behind the first dynode. When the beam strikes the solid portions along the length of the first dynode the excited electrons are multiplied and collected in separate collector electrodes spaced along the beam line. Similarly, the electrons excited when the beam strikes the second dynode are multiplied and collected in separate electrodes spaced along the length of the second dynode.

985

DE-ENTRAINMENT COLUMN. A. J. Mooradian (to U. S. Atomic Energy Commission). U. S. Patent 2,842,224. July 8, 1958.

A de-entrainment column is described for removing substances from a stream of vapor coming from a distillation apparatus. The device comprises a hollow cylindrical body mounted with its axis vertical on a flange on the upper side of a vaporizing vessel; two sintered metal circular discs through which all the vapor passes mounted in axially spaced relationship in the cylindrical body; and two semi-circular baffle plates mounted in spaced relationship between the discs.

986

POLAROGRAPH. J. W. Heyd and Philip E. Ohmart (to U. S. Atomic Energy Commission). U. S. Patent 2,842,736. July 8, 1958.

An improved polarograph device is described for determination of oxidation-reduction potentials. The device incorporates means for continuously varying the potential of one electrode without change in the potential of the other electrode. In addition, the invention provides for a substantial reduction in time required to obtain a polarogram by providing a continuously varying cell voltage, as contrasted with the prior point-to-point method, whereby no sheath is formed on the anode and no appreciable counter-E.M.F. is obtained.

987

PROCESSES OF RECOVERING URANIUM FROM A CALUTRON. D. O. Baird and L. R. Zumwalt (to U. S. Atomic Energy Commission). U. S. Patent 2,843,451. July 15, 1958.

An improved process is described for recovering the residue of a uranium compound which has been subjected to treatment in a calutron, from the parts of the calutron disposed in the source region upon which the residue is deposited. The process may be utilized when the uranium compound adheres to a surface containing metals of the group consisting of copper, iron, chromium, and nickel. The steps comprise washing the surface with an aqueous acidic oxidizing solvent for the uranium whereby there is obtained an acidic aqueous solution containing uranium as uranyl ions and metals of said group as impurities, treating the acidic solution with sodium acetate in the presence of added sodium nitrate to precipitate the uranium as sodium uranyl acetate away from the impurities in the solution, and separating the sodium uranyl acetate from the solution.

988

PRECIPITATION OF PROTACTINIUM. R. L. Moore (to U. S. Atomic Energy Commission). U. S. Patent 2,843,452. July 15, 1958.

An improvement in the separation of protactinium from aqueous nitric acid solutions is described. It covers the use of lead dioxide and tin dioxide as carrier precipitates for the protactinium. In carrying out the process, divalent lead or divalent tin is added to the solution and oxidized, causing formation of a carrier precipitate of lead dioxide or stannic oxide, respectively.

989

SEPARATION OF PLUTONYL IONS. R. E. Connick and Wm. H. McVey (to U. S. Atomic Energy Commission). U. S. Patent 2,843,453. July 15, 1958.

A process is described for separating plutonyl ions from the acetate ions with which they are associated in certain carrier precipitation methods of concentrating

plutonium. The method consists in adding alkaline earth metal ions and subsequently alkalizing the solution, causing formation of an alkaline earth plutonate precipitate. Barium hydroxide is used in a preferred embodiment since it provides alkaline earth metal ion and alkalizes the solution in one step forming insoluble barium plutonate.

990

HIGH TEMPERATURE BRAZING ALLOY FOR JOINT Fe–Cr–Al MATERIALS AND AUSTENITIC AND FERRITIC STAINLESS STEELS. R. C. Cost (to U. S. Atomic Energy Commission). U. S. Patent 2,843,478. July 15, 1958.

A new high temperature brazing alloy is described that is particularly suitable for brazing iron-chromium-aluminum alloys. It consists of approximately 20% Cr, 6% Al, 10% Si, and from 1.5 to 5% phosphorus, the balance being iron.

991

COATED ALLOYS. C. G. Harman and L. S. O'Bannon (to U. S. Atomic Energy Commission). U. S. Patent 2,843,500. July 15, 1958.

A coating is described for iron group metals and alloys, that is particularly suitable for use with nickel containing alloys. The coating is glassy in nature and consists of a mixture containing an alkali metal oxide, strontium oxide, and silicon oxide. When the glass coated nickel base metal is "fired" at less than the melting point of the coating, it appears the nickel diffuses into the vitreous coating, thus providing a closely adherent and protective cladding.

992

NUCLEAR REACTOR. R. F. Christy (to U. S. Atomic Energy Commission). U. S. Patent 2,843,543. July 15, 1958.

A nuclear reactor of the homogeneous liquid fuel type is described wherein the fissionable isotope is suspended or dissolved in a liquid moderator such as water. The reactor core is comprised essentially of a spherical vessel for containing the reactive composition surrounded by a reflector, preferably of beryllium oxide. The reactive composition may be an ordinary water solution of a soluble salt of uranium, the quantity of fissionable isotope in solution being sufficient to provide a critical mass in the vessel. The liquid fuel is stored in a tank of non-critical geometry below the reactor vessel and outside of the reflector and is passed from the tank to the vessel through a pipe connecting the two by air pressure means. Neutron absorbing control and safety rods are operated within slots in the reflector adjacent to the vessel.

993

TRANSISTOR HIGH VOLTAGE POWER SUPPLY. G. E. Driver (to U. S. Atomic Energy Commission). U. S. Patent 2,843,815. July 15, 1958.

High voltage, direct current power supplies are described for use with battery powered nuclear detection equipment. The particular advantages of the power supply described, are increased efficiency and reduced size and weight brought about by the use of transistors in the circuit. An important feature resides in the employment of a pair of transistors in an alternate-firing oscillator circuit having a coupling transformer and other circuit components which are used for interconnecting the various electrodes of the transistors.

994

THERMO-ELECTRIC GENERATOR. K. C. Jordan (to U. S. Atomic Energy Commission). U. S. Patent 2,844,639. July 22, 1958.

The conversion of heat energy into electrical energy by a small compact device is described. Where the heat energy is supplied by a radioactive material and thermopiles convert the heat to electrical energy. The particular battery construction includes two insulating discs with conductive rods disposed between them to form a circular cage. In the center of the cage is disposed a cup in which the sealed radioactive source is located. Each thermopile is formed by connecting wires from two adjacent rods to a point on an annular ring fastened to the outside of the cup, the ring having insulation on its surface to prevent electrical contact with the thermopiles. One advantage of this battery construction is that the radioactive source may be inserted after the device is fabricated, reducing the radiation hazard to personnel assembling the battery.

995

METHOD OF TESTING FOR LEAKS. E. C. Creutz, Wm. A. McAdams, and M. H. Foss (to U. S. Atomic Energy Commission). U. S. Patent 2,844,735. July 22, 1958.

A method is described for detecting minute holes in fuel element jackets. The method comprises submerging the jacketed body in an atmosphere of a radioactive gas under pressure, the radioactive emanations from said gas being sufficiently penetrating to penetrate the jacket of the jacketed body. After the jacketed body is removed from the radioactive gas atmosphere, it is examined for the presence of emanations from radioactive gas which entered the jacketed body through the minute holes. In this manner, the detection of radioactive emanations is a positive indication that the fuel element is not perfectly sealed.

996

MULTIPLE SPARK GAP SWITCH. A. E. Schofield (to U. S. Atomic Energy Commission). U. S. Patent 2,844,740. July 22, 1958.

A multiple spark gap switch of unique construction is described which will permit controlled, simultaneous discharge of several capacitors into a load. The switch construction includes a disc electrode with a plurality of protuberances of generally convex shape on one surface. A firing electrode is insulatingly supported in each of the electrode protuberances and extends substantially to the apex thereof. Individual electrodes are disposed on an insulating plate parallel with the disc electrode to form a number of spark gaps with the protuberances. These electrodes are each connected to a separate charged capacitor and when a voltage is applied simultaneously between the trigger electrodes and the disc electrode, each spark gap fires to connect its capacitor to the disc electrode and a subsequent load.

997

PULSE SORTER. E. J. Wade (to U. S. Atomic Energy Commission). U. S. Patent 2,845,530. July 29, 1958.

An apparatus is described for counting and recording the number of electrical pulses occurring in each of a timed sequence of groups of pulses. The particular feature of the invention resides in a novel timing circuit of the univibrator type which provides very accurately timed pulses for opening each of a series of coincidence channels in sequence. The univibrator is shown incorporated in a pulse analyzing system wherein a series of pulse counting channels are periodically opened in order, one at a time, for a predetermined open time interval, so that only one channel will be open at the time of occurrence of any of the electrical pulses to be sorted.

998
NEUTRON MEASURING METHOD AND APPARATUS. G. T. Seaborg, G. Friedlander, and J. W. Gofman. (to U. S. Atomic Energy Commission). U. S. Patent 2,845,544. July 29, 1958.

A fast neutron fission detecting apparatus is described consisting of a source of fast neutrons, an ion chamber containing air, two electrodes within the ion chamber in confronting spaced relationship, a high voltage potential placed across the electrodes, a shield placed about the source, and a suitable pulse amplifier and recording system in the electrode circuit to record the impulse due to fissions in a sample material. The sample material is coated onto the active surface of the disc electrode and shielding means of a material having high neutron capture capabilities for thermal neutrons are provided in the vicinity of the electrodes and about the ion chamber so as to absorb slow neutrons of thermal energy to effectively prevent their diffusing back to the sample and causing an error in the measurement of fast neutron fissions.

999
NEUTRON COUNTER. C. D. Curtis, R. L. Carlson, and M. P. Tubinis (to U. S. Atomic Energy Commission). U. S. Patent 2,845,560. July 29, 1958.

An ionization chamber instrument is described for measuring neutron flux comprising two coaxial spaced cylindrical electrodes with an ionizing gas filling the chamber. The inner electrode is held in place by a hermetic insulating seal at one end of the outer electrode, the other end of the outer electrode being closed by a gas filling tube. The outer surface of the inner electrode is coated with an active material which is responsive to neutron bombardment, such as uranium-235 or boron-10, to produce ionizing radiations in the gas. The transverse cross sectional area of the inner electrode is small in relation to that of the chamber whereby substantially all of the radiations are directed toward the outer electrode.

1000
PEAK READING VOLTMETER. A. L. Dyer (to U. S. Atomic Energy Commission). U. S. Patent 2,845,596. July 29, 1958.

An improvement in peak reading voltmeters is described, which provides for storing an electrical charge representative of the magnitude of a transient voltage pulse and thereafter measuring the stored charge, drawing only negligible energy from the storage element. The incoming voltage is rectified and stored in a condenser. The voltage of the capacitor is applied across a piezoelectric crystal between two parallel plates. Any change in the voltage of the capacitor is reflected in a change in the dielectric constant of the crystal and the capacitance between a second pair of plates affixed to the crystal is altered. The latter capacitor forms part of the frequency determining circuit of an oscillator and means is provided for indicating the frequency deviation which is a measure of the peak voltage applied to the voltmeter.

1001
ALIGNING JIG. J. S. Culver and W. C. Tunnell (to U. S. Atomic Energy Commission). U. S. Patent 2,845,716. Aug. 5, 1958.

A jig or device is described for setting or aligning an opening in one member relative to another member or structure, with a predetermined offset, or it may be used for measuring the amount of offset with which the parts have previously been set. This jig comprises two blocks rabbeted to each other, with means for securing the upper block to the lower block. The upper block has fingers for contacting one of the members to be aligned, the lower block is designed to ride in grooves within the reference member, and calibration marks are provided to determine the amount of offset. This jig is specially designed to align the collimating slits of a mass spectrometer.

1002
CAN HANDLING FIXTURES. LeR. R. Kelman and F. L. Yaggee (to U. S. Atomic Energy Commission). U. S. Patent 2,845,762. Aug. 5, 1958.

A sleeveless canning apparatus is described for bonding and canning uranium fuel elements under the surface of a liquid bonding alloy. The can is supported on a pedestal by vertical pegs, and an adjustable collar is placed around the upper, open end of the can, which preferably is flared to assure accurate centering in the fixture and to guide the uranium slug into the can. The fixture with a can in place is then immersed in a liquid aluminum-silicon alloy and the can becomes filled with the liquid alloy. The slug is inserted by a slug guide located vertically above the can opening. The slug settles by gravity into the can, after which a cap is emplaced. A quenching tool lifts the capped can out of the bath by means of a slot provided for it in the pedestal. This apparatus provides a simple means of canning the slug without danger of injury to the uranium metal or the aluminum can.

1003
ELECTRONIC MASTER SLAVE MANIPULATOR. R. C. Goertz, Wm. M. Thompson, and R. A. Olsen (to U. S. Atomic Energy Commission). U. S. Patent 2,846,084. Aug. 5, 1958.

A remote control manipulator is described in which the master and slave arms are electrically connected to produce the desired motions. A response signal is provided in the master unit in order that the operator may sense a feel of the object and may not thereby exert such pressures that would ordinarily damage delicate objects. This apparatus will permit the manipulation of objects at a great distance, that may be viewed over a closed TV circuit, thereby permitting a remote operator to carry out operations in an extremely dangerous area with complete safety.

1004
SQUARE WAVE AMPLIFIER. M. A. Leavitt and I. C. Lutz (to U. S. Atomic Energy Commission). U. S. Patent 2,846,523. Aug. 5, 1958.

An amplifier circuit is described for amplifying signals having an alternating current component superimposed upon a direct current component, without loss of any segment of the alternating current component. The general circuit arrangement includes a vibrator, two square wave amplifiers, and recombination means. The amplifier input is connected to the vibrating element of the vibrator and is thereby alternately applied to the input of each square wave amplifier. The detailed circuitry of the recombination means constitutes the novelty of the amplifier and consists of a separate, dual triode amplifier coupled to the output of each square wave amplifier with a recombination connection from the plate of one amplifier section to a grid of one section of the other amplifier. The recombination circuit has provisions for correcting distortion caused by overlapping of the two square wave voltages from the square wave amplifiers.

1005
METAL PLATING PROCESS. D. E. Walker and R. A.

Noland (to U. S. Atomic Energy Commission). U. S. Patent 2,846,762. Aug. 12, 1958.

A process is described for obtaining a closely bonded coating of steel or iron on uranium. The process consists of providing, between the steel and uranium, a layer of silver, and then pressure rolling the assembly at about 600°C until a reduction of from 10 to 50% has been obtained.

1006

LEAKAGE TESTING METHOD. Wm. A. McAdams and M. H. Foss (to U. S. Atomic Energy Commission). U. S. Patent 2,846,872. Aug. 12, 1958.

A method of testing containers for leaks is described, particularly the testing of containers or cans in which the uranium slugs for nuclear reactors are jacketed. This method involves the immersion of the can in water under 150 pounds of pressure, then removing, drying, and coating the can with anhydrous copper sulfate. Any water absorbed by the can under pressure will exude and discolor the copper sulfate in the area about the leak.

1007

PULSE AMPLITUDE DISTRIBUTION RECORDER. George Cowper (to U. S. Atomic Energy Commission). U. S. Patent 2,847,268. Aug. 12, 1958.

A device is described for automatically recording pulse amplitude distribution received from a counter. The novelty of the device consists of the over-all arrangement of conventional circuit elements to provide an easy to read permanent record of the pulse amplitude distribution during a certain time period. In the device a pulse analyzer separates the pulses according to amplitude into several channels. A scaler in each channel counts the pulses and operates a pen marker positioned over a drivable recorder sheet. Since the scalers in each channel have the same capacity, the control circuitry permits counting of the incoming pulses until one scaler reaches capacity, whereupon the input is removed and an internal oscillator supplies the necessary pulses to fill up the other scalers. Movement of the chart sheet is initiated when the first scaler reaches capacity to thereby give a series of marks at spacings proportional to the time required to fill the remaining scalers, and accessory equipment marks calibration points on the recorder sheet to facilitate direct reading of the number of external pulses supplied to each scaler.

1008

CALUTRON OSCILLOGRAPH SYSTEM. Q. A. Kerns (to U. S. Atomic Energy Commission). U. S. Patent 2,847,270. Aug. 12, 1958.

Circuits and equipment useful in connection with the determination of the coordinate points of maximum intensity of a calutron ion beam is described. The broad aspects of the apparatus include a novel sweep circuit for generating a voltage applied to the calutron deflection plates for deflecting the ion beam in a single direction, apparatus for recording beam intensity at selected beam traversal points, and control means for terminating the sweep and stopping the recording apparatus. In addition, a circuit is provided which is responsive to sparking at the deflection electrodes, and a signal device does not operate unless the deflection run is free of sparking interference.

1009

MANGANESE DIOXIDE METHOD FOR PREPARATION OF PROTACTINIUM. L. I. Katzin (to U. S. Atomic Energy Commission). U. S. Patent 2,847,273. Aug. 12, 1958.

A method of obtaining U^{233} is described. An aqueous solution of neutron irradiated thorium is treated by forming therein a precipitate of manganese dioxide which carries and thus separates the Pa^{233} from the solution. The carrier precipitate so formed is then dissolved in an acidic solution containing a reducing agent sufficiently electronegative to reduce the tetravalent manganese to the divalent state. Further purification of the Pa^{233} may be obtained by forming another manganese dioxide carrier precipitate and subsequently dissolving it. After a sufficient number of such cycles have brought the Pa^{233} to the desired purity, the solution is aged, allowing the formation of U^{233} by radioactive decay. A manganese dioxide precipitate is then formed in the U^{233} containing solution. This precipitate carries down any remaining Pa^{233} thus leaving the separated U^{233} in solution, from which it may be easily recovered.

1010

SULFIDE METHOD PLUTONIUM SEPARATION. R. B. Duffield (to U. S. Atomic Energy Commission). U. S. Patent 2,847,274. Aug. 12, 1958.

A process is described for the recovery of plutonium from neutron irradiated uranium solutions. Such a solution is first treated with a soluble sulfide, causing precipitation of the plutonium and uranium values present, along with those impurities which form insoluble sulfides. The precipitate is then treated with a solution of carbonate ions, which will dissolve the uranium and plutonium present while the fission product sulfides remain unaffected. After separation from the residue, this solution may then be treated by any of the usual methods, such as formation of a lanthanum fluoride precipitate, to effect separation of plutonium from uranium.

1011

URANIUM RECOVERY PROCESS. J. H. Yeager (to U. S. Atomic Energy Commission). U. S. Patent 2,847,275. Aug. 12, 1958.

In the prior art processing of uranium ores, the ore is first digested with nitric acid and filtered, and the uranium values are then extracted from the filtrate by contacting with an organic solvent. The insoluble residue has been processed separately in order to recover any uranium which it might contain. The improvement consists in contacting a slurry, composed of both solution and residue, with the organic solvent prior to filtration. The result is that uranium values contained in the residue are extracted along with the uranium values contained in the solution in one step.

1012

SOLVENT EXTRACTION OF NEPTUNIUM. J. P. Butler (to U. S. Atomic Energy Commission). U. S. Patent 2,847,276. Aug. 12, 1958.

A process is described for the recovery of neptunium from dissolver solutions by solvent extraction. The neptunium containing solution should be about 5N, in nitric acid and about 0.1 M in ferrous ion. The organic extracting agent is tributyl phosphate, and the neptunium is recovered from the organic solvent phase by washing with water.

1013

PRECIPITATION OF URANIUM PEROXIDE OF LOW FLUORIDE CONTENT FROM SOLUTIONS CONTAINING FLUORIDES. E. J. King and H. M. Clark (to U. S. Atomic Energy Commission). U. S. Patent 2,847,277. Aug. 12, 1958.

A method is described for the preparation of fluoride free uranium peroxide precipitates, even though the solution from which the precipitation is made is contaminated with fluorides. This is accomplished by add-

ing aluminum ions to the solution, where they complex any fluoride present and prevent its precipitation with the uranium peroxide.

1014

PRECIPITATION OF ZIRCONIUM, NIOBIUM, AND RUTHENIUM FROM AQUEOUS SOLUTIONS. A. S. Wilson (to U. S. Atomic Energy Commission). U. S. Patent 2,847,278. Aug. 12, 1958.

An improvement on the "head end process" for decontaminating dissolver solutions of their Zr, Nl, and Ru values. The process consists in adding a water soluble symmetrical dialkyl ketone, e.g., acetone, before the formation of the manganese dioxide precipitate. The effect is that upon digestion, the ruthenium oxide does not volatilize, but is carried on the manganese dioxide precipitate.

1015

PULSED MIXER-SETTLER SOLVENT EXTRACTION CONTACTORS. W. S. Figg (to U. S. Atomic Energy Commission). U. S. Patent 2,847,283. Aug. 12, 1958.

A mixer–settler extractor is described for contacting immiscible liquids having different specific gravities in order to withdraw one or more components from one liquid with the aid of the other liquid. The extractor consists of a hollow column, a rotary drive shaft extending through the column with a number of impellers spaced thereon, an equal number of separator plate sets each consisting of one fluorothene and one stainless steel plate with peripheral recesses and flow slots mounted on the column, and a pulse generator. This apparatus is particularly useful in solvent extraction processes for recovering plutonium from aqueous acidic solutions of irradiated uranium.

1016

APPARATUS FOR CATALYTICALLY COMBINING GASES. H. M. Busey (to U. S. Atomic Energy Commission). U. S. Patent 2,847,284. Aug. 12, 1958.

A convection type recombiner is described for catalytically recombining hydrogen and oxygen which have been radiolytically decomposed in an aqueous homogeneous nuclear reactor. The device is so designed that the energy of recombination is used to circulate the gas mixture over the catalyst. The device consists of a vertical cylinder having baffles at its lower end, above these coarse screens having platinum and alumina pellets cemented thereon, and an annular passage for the return of recombined, condensed water to the reactor moderator system. This device, having no moving parts, provides a simple and efficient means of removing the danger of accumulated hot radioactive, explosive gases, and restoring them to the moderator system for reuse.

1017

METAL SURFACE TREATMENT. L. D. Eubank (to U. S. Atomic Energy Commission). U. S. Patent 2,847,321. Aug. 12, 1958.

Improved flux baths are described for use in conjunction with hot dipped coatings for uranium. The flux bath consists of molten alkali metal, or alkaline earth metal halides. One preferred embodiment comprises a bath containing molten KCl, NaCl, and LiCl in proportions approximating the triple eutectic.

1018

HYDROGEN ISOTOPE TARGETS. R. W. Ashley (to U. S. Atomic Energy Commission). U. S. Patents 2,847,331. Aug. 12, 1958.

The design of targets for use in the investigation of nuclear reactions of hydrogen isotopes by bombardment with accelerated particles is described. The target construction comprises a backing disc of a metal selected from the group consisting of molybdenum and tungsten, a coating of condensed titanium on the disc, and a hydrogen isotope selected from the group consisting of deuterium and tritium absorbed in the coating. The process for preparing these hydrogen isotope targets is described.

1019

CALUTRONS. E. D. Kane (to U. S. Atomic Energy Commission). U. S. Patent 2,847,575. Aug. 12, 1958.

A system of calutrons is described employing a novel arrangement for maintaining a magnetic field. Several tanks, each containing an electromagnetic ion separating mechanism, are coaxially arranged in abutting relationship. The required magnetic field is provided by windings surrounding the series tanks and inclined to the axis of the series tanks so as to leave one edge wall of each tank clear and unobstructed for access into the tank. An important advantage of the disclosed construction is the calutron system does not require the use of expensive and bulky cores.

1020

CALUTRON SYSTEM. E. O. Lawrence (to U. S. Atomic Energy Commission). U. S. Patent 2,847,576. Aug. 12, 1958.

A calutron system capable of functioning with only a portion of the separation tanks in the system operating is described. The invention is a calutron system comprising a closed series of alternated tanks and electromagnets having a mid-yoke connecting intermediate positions of the series, dividing the series into two portions, and thereby providing a closed magnetic path through either of the portions.

1021

CALUTRON. F. H. Schmidt (to U. S. Atomic Energy Commission). U. S. Patent 2,847,577. Aug. 12, 1958.

An improved ion source is described for accurately presetting the size and location of the gas and ion efflux opening, for determining the contour of the electrical field in the vicinity of the arc, and for generally improving the operation of the calutron source. The above features are accomplished by the use of a pair of electrically conductive coplanar plates mounted on opposite sides of the ion exit passage of the source ionization chamber and electrically connected to the source block. The plates are mounted on the block for individual movement transversely of the exit slit and can be secured in place by clamping means.

1022

ELECTRICAL REGULATING APPARATUS INCLUDING AN IONIC CURRENT REGULATOR. H. W. Brackney (to U. S. Atomic Energy Commission). U. S. Patent 2,847,635. Aug. 12, 1958.

An apparatus is described for regulating the operation of an electromagnetic charged particle separator. It consists of an electrical circuit for improving the regulation of the accelerating voltage of a calutron when the ionic current regulator control means is disconnected. The novel circuit arrangement connects the input of the ionic current regulator to a voltage divider, in association with a second voltage regulator, to furnish an accelerating voltage output which remains constant at a mean value instead of zero as has been the practice.

1023

HIGH SENSITIVITY ELECTROSCOPE. F. R. Shonka and A. J. Oklesheh (to U. S. Atomic Energy Commission). U. S. Patent 2,847,644. Aug. 12, 1958.

An electrometer with dependable and rugged construction for measuring extremely small charges is de-

scribed. The electrometer arrangement comprises an electrically conducting fiber totally disposed in a single plane in the absence of electrostatic forces and affixed at both ends to fiber support means. The fiber is provided with a plurality of adjacent bends in opposite directions along its length. An electrode is disposed between two adjacent bends to apply an electrostatic force normal to the plane of the fiber whereby the fiber is caused to twist out of its plane in proportion to the potential applied between the fiber and the electrode.

1024

REMOTE RETRIEVING TOOL. L. W. Fromm, Jr. (to U. S. Atomic Energy Commission). U. S. Patent 2,848,266. Aug. 19, 1958.

A retrieving tool is described to securely grasp an object for emplacement in, or withdrawal from, an elongated tube. The object is grasped by hooks actuated by a wedge and cam mechanism. The mechanism on the end of a long rodlike structure is controlled by levers or bars at the access end of the tube. This device is particularly useful for positioning fuel elements within a reactor core.

1025

PROCESS OF SEPARATING URANIUM FROM AQUEOUS SOLUTION BY SOLVENT EXTRACTION. J. C. Warf (to U. S. Atomic Energy Commission). U. S. Patent 2,848,300. Aug. 19, 1958.

A process is described for separating uranium values from aqueous uranyl nitrate solutions. The process consists in contacting the uranium bearing solution with an organic solvent, tributyl phosphate, preferably diluted with a less viscous organic liquid, whereby the uranyl nitrate is extracted into the organic solvent phase. The uranyl nitrate may be recovered from the solvent phase by back extracting with an aqueous medium.

1026

SEPARATION OF PLUTONIUM HYDROXIDE FROM BISMUTH HYDROXIDE. G. W. Watt (to U. S. Atomic Energy Commission). U. S. Patent 2,848,301. Aug. 19, 1958.

An improved method is described for separating plutonium hydroxide from bismuth hydroxide. The end product of the bismuth phosphate processes for the separation and concentration of plutonium is a mixture of bismuth hydroxide and plutonium hydroxide. It has been found that these compounds can be advantageously separated by treatment with a reducing agent having a potential sufficient to reduce bismuth hydroxide to metallic bismuth but not sufficient to reduce the plutonium present. The resulting mixture of metallic bismuth and plutonium hydroxide can then be separated by treatment with a material which will dissolve plutonium hydroxide but not metallic bismuth. Sodium stannite is mentioned as a preferred reducing agent, and dilute nitric acid may be used as the separatory solvent.

1027

FUEL ELEMENTS FOR NUCLEAR REACTORS AND PROCESS OF MAKING. W. E. Roake (to U. S. Atomic Energy Commission). U. S. Patent 2,848,325. Aug. 19, 1958.

A process is described for producing uranium metal granules for use in reactor fuel elements. The granules are made by suspending powdered uranium metal or uranium hydride in a viscous, non-reactive liquid, such as paraffin oil, and pouring the resulting suspension in droplets on to a bed of powdered absorbent. In this manner the liquid vehicle is taken up by the sorbent and spherical pellets of uranium metal are obtained. The pellets are heated to drive off the remaining liquid vehicle, and calcined to give a hard dense product.

1028

NITRIC ACID PICKLING PROCESS. E. R. Boller and L. D. Eubank (to U. S. Atomic Energy Commission). U. S. Patent 2,848,351. Aug. 19, 1958.

An improved process is described for the treatment of metallic uranium surfaces preparatory to being given hot dip coatings. The process consists in first pickling the uranium surface with aqueous 50% to 70% nitric acid, at 60 to 70°C, for about 5 minutes, rinsing the acid solution from the uranium article, promptly drying and then passing it through a molten alkali-metal halide flux consisting of 42% LiCl, 53% KCl, and 5% NaCl into a molten metal bath consisting of 85 parts by weight of zinc and 15 parts by weight of aluminum.

1029

FUEL ELEMENTS AND METHOD OF MAKING. R. A. Noland and C. Marzano (to U. S. Atomic Energy Commission). U. S. Patent 2,848,352. Aug. 19, 1958.

A process is described of surface-impregnating bodies of metallic uranium with silicon. Silicon metal is added to or admixed with alkali metal selected from the group consisting of sodium, potassium, and sodium-potassium alloy. The uranium body is then immersed in the mixture obtained and the temperature is raised to between 425 and 600°C. The silicon is dissolved and deposits as a uranium-silicon compound on the uranium body.

1030

NUCLEAR REACTOR. M. Treshow (to U. S. Atomic Energy Commission). U. S. Patent 2,848,404. Aug. 19, 1958.

A neuclear reactor is described of the heterogeneous type and employing replaceable tubular fuel elements and heavy water as a coolant and moderator. A plurality of fuel tubes, having their axes parallel, extend through a tank type pressure vessel which contains the liquid moderator. The fuel elements are disposed within the fuel tubes in the reactive portion of the pressure vessel during normal operation and the fuel tubes have removable plug members at each end to permit charging and discharging of the fuel elements. The fuel elements are cylindrical strands of jacketed fissionable material having helical exterior ribs. A bundle of fuel elements are held within each fuel tube with their longitudinal axes parallel, the ribs serving to space them apart along their lengths. Coolant liquid is circulated through the fuel tubes between the spaced fuel elements. Suitable control rod and monitoring means are provided for controlling the reactor.

1031

ION SOURCE UNIT FOR A CALUTRON. W. M. Brobeck (to U. S. Atomic Energy Commission). U. S. Patent 2,848,619. Aug. 19, 1958.

An improvement in the ion-producing mechanism for use in a calutron is described. In its broad aspects the improvement comprises the addition of shield plates between the electron emitting filament of the ion source and the ionization chamber. An aperture in one of the shields provides a path for electrons from the filament to enter the ionization chamber of the source block. As the shield members are electrically connected to the negative side of the filament power supply, the favorable action of the upper shield is to prevent the electron bombardment of all the elements of the calutron which overlie the filament, and the lower shield member con-

fines the emission of electrons from the filament to a relatively short segment, thereby increasing the life of the filament.

1032

ION PRODUCING MECHANISM. J. G. Backus (to U. S. Atomic Energy Commission). U. S. Patent 2,848,620. Aug. 19, 1958.

A novel ion source is described for use in a calutron which has the prime advantage of reducing the number of unwanted ions in the ion generating mechanism. An important feature of the invention resides in an arc chamber having a lining of the polyisotopic material to be treated in the calutron and bombardment of the lining with positive ions of a light gas to induce sputtering and ionization of the lining. With the reduction of unwanted ions in the source beam provided by the described source, the calutron operation may be more accurately controlled.

1033

CALUTRON ION SOURCE. F. Oppenheimer (to U. S. Atomic Energy Commission). U. S. Patent 2,848,621. Aug. 19, 1958.

An improvement in the design of ion sources for calutrons is described. It consists of a source filament having a mounting and configuration conducive to a quick removal and change, while at the same time fully resisting the deflection force of the calutron magnetic field. The filament configuration is a helical midsection with the filament ends extending in the same direction parallel to the axis of the helix. Two gripping terminals and leads are so positioned that the filament may be slipped into transverse grooves in the terminals and secured in position adjacent a passage into the ionization chamber of the source block.

1034

CALUTRON ION SOURCE. F. Oppenheimer (to U. S. Atomic Energy Commission). U. S. Patent 2,848,622. Aug. 19, 1958.

The construction of an ion source is described wherein a uniform and elongated arc is established for employment in a calutron. The novel features of the source include the positioning of a cathode at one end of an elongated exit slit of an arc chamber, and anode electrodes defining the longitudinal margins of the exit opening. When the exit slit is orientated in a parallel relation to a magnetic field, the arc extends in the direction of the magnetic field along and between the anode electrodes, which are held at a positive potential with respect to the cathode.

1035

GAMMA AND X-RAY DOSIMETER AND DOSIMETRIC METHOD. G. V. Taplin, C. H. Douglas, and S. C. Sigoloff (to U. S. Atomic Energy Commission). U. S. Patent 2,848,625. Aug. 19, 1958.

An improvement in colorimetric gamma and x-ray dosimeter systems and a self-contained, hand carried dosimeter of the afore-mentioned type is described. A novel point of the invention lies in the addition of specific quantities of certain normalizing agents to the two phase chlorinated hydro-carbon-aqueous dye colorimetric dosimeter to eliminate the after reaction and thereby extend the utility of such system. The structure of the two phase colorimetric dosimeter tubes and the carrying case for the tubes of the portable dosimeter are unique features.

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